POWER

Established 1884—McGraw-Hill Publishing Company, Inc.
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VOLUME 76 OCTOBER, 1932 NUMBER 4

EDITORIALS

Coal Mines Move to Reduce Power Costs

Coal mines are taking a decided interest of late in the possibility of making their own power for several important reasons. A large part of the power load at any coal mine is required for hoisting operations. It is characteristic that this type of load shall consist of high peak demands for short intervals, followed by periods of low consumption with intervals of little or no consumption between. When power for this type of load is purchased at rates based upon peak demand, the power bill is not infrequently as much as ten per cent of the total per-ton cost of the coal mined. In some cases the proportion is even greater.

This situation together with the growing tonnage of rejected fuel, discarded by the classification process now almost universally required in order to produce coal of standard quality for the consumer market, has quickened the interest of the mine operators in the making of their own power.

Technical difficulties which have held this class of development back in the past, such as speed regulation of the small isolated plants and limited water supply, are engaging the attention of power machinery builders and consulting engineers. Because of the vast supply of available fuel which would otherwise continue to be nothing more than mine waste, there is little necessity for high efficiency in power plant operation. Improved cooling tower design adds further possibility to water conservation, although in many cases non-condensing engines will be used.

Altogether, there is strong evidence that the coal mine operators are considering their power requirements from a new point of view and that a pressure for the reduction of operating costs is responsible.

An Engineering Opportunity Lost

There appears elsewhere in this issue an article entitled "The Boston Post Office—A Heat and Power Analysis." While the story ably fulfills its mission in these respects, it does another thing fully as important. It describes the engineering layout and arrangement of the boilers, coal bins and heating facilities, and then proceeds competently to point out the lack of engineering judgment so apparent in the arrangement. This plant seems to have been developed with more of the architect's eye to symmetry than the engineer's view to practical and economic operation.

But whatever the excuse for the arrangement may be, it is not possible to believe that a better plan could not have been devised to the decided advantage of operating economy. That even with the existing arrangement, the installation should be a money saver for the United States Post Office Department is fortunate. But this fact only more clearly emphasizes what further savings have been sacrificed to poor engineering.

Solid CO_2 and Heat Balance

Power technique is always on the move. This is proved again by the advent of carbon-dioxide ice as a "filler" to improve heat balance.

It has often been stated that the heat balance of an industrial plant is perfect when the power produceable as a byproduct of process heat equals the factory power demand. Additional power produceable from such steam had no place to go, hence no value.

Then came the beginnings of power exchange between industrials and utilities and with it an unlimited surplus power market for certain industrials. Such plants can improve the heat balance without limit by generating more and more power from process steam.

Now comes solidified carbon dioxide, or "dry ice," as a reservoir for saleable power. The plan has been neatly worked out in the Pennsylvania sugar plant described in a recent number of *Power*. There is available CO_2 from distillation processes, as well as excess power at certain hours. Two plus two equals four, and excess power plus CO_2 equals carbon dioxide ice if designers and operators say so.

An obvious point for solidified CO_2 as a power sponge is the fact that its power consumption can generally be scheduled to utilize the excess-energy peaks and to dodge the valleys.

Here again is proof that "there is more than one way to kill a cat."

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POWER Stands for . .

1. Making Power When It Should Be Made
2. Buying Power When It Should Be Bought
3. Cheaper Power Through Modern Equipment
4. Easier Financing of Equipment Purchases
5. Better Use of Byproduct Heat and Power
6. Operating Methods That Save Money
7. Less Waste in Transmission and Application
8. Prevention of Smoke, Within Reason

CREDIT OR COURAGE?

. . . Power Equipment

EVERYONE is vitally interested in knowing whether or not there is a reasonable likelihood that the industrial life of the world in general, and the United States in particular, may expect an early return of conditions which will assure work enough for everyone, at wages or salaries which will revitalize purchasing power and thus set into motion the upbuilding forces to prosperity.

Although it is undoubtedly true, in many cases, that unwillingness of the banks to extend credits upon acceptable terms has been one of the major influences retarding the return of business activity, it has always been doubtful that this condition extended into the field of power generation and utilization.

To find the correct answer and to gather irrefutable information with which to present the case of the power field to the banking and industrial committees in the various Federal Reserve districts of the country, *Power* has gone directly to each group of representative manufacturers of power equipment to find the answer. Each manufacturer approached was requested to report the observations and experience for his entire class of manufactures, not only for himself.

THE following questions were asked:

1. Approximately what amount of business in dollars have you at present in hand and in prospect, for the modernization of existing power plants of all kinds? (It is not desired that this figure shall include the building of new plants to increase the ultimate power capacity, but only those plants which replace existing capacity or modernize it in a way which will reduce the cost of power production . .)

"2. Approximately what proportion of this business would, in your opinion, be placed immediately, (a) if local banks were persuaded to extend credit for an enterprise of this sort to worthy companies, or (b) if it were possible to overcome the unwillingness of prospects to ask credit or to spend money from their own surpluses, or to take any aggressive step until they can see with their own eyes that times are definitely, and with certainty, moving upward?"

Seventy-five per cent of those written to gave complete replies. Each reply was signed by an authoritative member of the company, such as the president, vice-president or sales manager.

In addition to the replies received from consulting engineers, the answers were representative of the following power equipment fields: Boilers, stokers, steam turbines, motors and electrical equipment, pumps, condensers, piping, control, boiler-room equipment, diesel engines, hydraulic turbines, impulse wheels.

REPLIES to question No. 1 are in unanimous agreement that there are orders in sight, running into many millions of dollars, and that there is an impressive volume of prospective business upon which estimates have been made at purchasers' requests and firm prices offered. It is also unmistakable that this business is not closing and it evidently will not, "unless business picks up."

Replies to questions Nos. 2a and 2b indicate, beyond any doubt, that bank credit is not a major factor in the situation. Many point out that even in the face of large cash surpluses companies are refusing to place business.

It may be significant, however, that two companies reporting on this point cite instances where banking influence on the board of directors of industrial companies has prevented the placing of orders for approximately $10,000 in one case and $18,000 in another, where the rate of return upon capital expenditure from increased savings in power cost would have been about 35 per cent per annum in one case and 76 per cent per annum in the other.

Another reply cites the reluctance of plant superintendents and managers, who are directly in charge, to propose improvements requiring cash expenditure regardless of the high rate of return from savings effected. It is said that many men in these classes of positions have become afraid to suggest what they know to be necessary and highly desirable improvements, regardless of their merit, simply because they require an expenditure of capital.

THE reports clearly develop and confirm previous indications that for the most part the reluctance of prospective purchasers to place orders for much needed equipment for power plant modernization is not a matter of securing or having been refused bank credit. On the contrary, it arises from an apparently strong conclusion that no capital investment should be made under present conditions or until business has taken a definite upward turn. To explain the significance of this attitude, one must remember that this survey takes no account of projects to increase plant capacity, but only those desirable for reducing operating costs.

Of the nine consulting engineers, only one attaches importance to limitations in bank credit. One prominent New York consulting engineer says:

"Business in hand or in prospect for the modernization of existing power plants is in the order of $3,000,000, which, expended along the lines of our plans, would reduce operating costs about $1,500,000 a year." Fifty per cent return, now, but, "our clients and prospects take the stand that they want to see business improve substantially before they go ahead." However, he continues, "we find an increasingly better feeling among our clients and prospects. The opinion is expressed that . . . . the way is prepared for an upturn. Furthermore, many businesses have already felt this upturn and are doing well."

Leaders Spot Key Log in Economic Jam

Discussing credit limitation, a boiler manufacturer cites 13 jobs totalling $882,000 awaiting bank cooperation and 46 jobs, totalling $891,000, held up for reasons other than lack of funds or bank credit.

A STOKER manufacturer sees $2,500,000 worth of business awaiting action and estimates that $1,500,000 of this is in no way limited by lack of bank credit.

One turbine manufacturer estimates that recognized needs for plant modernization would open up to all manufacturers about $3,000,000 worth of business in turbines under 2,500 kw. and that two-thirds of this is held up because buyers, who have or can get the money, will not act now.

A manufacturer of pumps and other power equipment has orders totalling $600,000, but sees possible purchases in his field of $12,000,000 when present buying restrictions are removed. He does not specify what fraction of this is held up for lack of bank credit.

Four manufacturers of boiler-room accessories refer to much business in sight but few orders. In two cases out of three the key log is unwillingness to act rather than a lack of funds or credit.

An industrial vice-president quoted by one of these manufacturers says that his company has $250,000 in the bank for power plant modernization but that not one cent of this will be spent until the management is convinced that business has reached rock bottom and is beginning to move upward. Meanwhile, cost leaks continue in this plant at a rate that would pay very handsome dividends on relatively idle funds in the bank.

An air preheater manufacturer says that lack of bank credit is hardly an appreciable factor in holding up orders in his field.

IN THE diesel field, according to one manufacturer, business of $10,000,000 is in prospect and held up for lack of will to buy now rather than shortage of funds or credit.

Manufacturer after manufacturer reports bid upon bid and orders held up. Often the ratio of eligible jobs to those placed is as high as ten to one. The mere will to act—to start saving now rather than next year—will transform the greater part of these into orders and set equipment factories to work full time, perhaps overtime.

This is the present picture, uncolored by mere opinion. It points a clear road to a rapid improvement in general business through the application of common sense to the powerful motive of individual profit.

What to Do Now

• A distinct change of sentiment has come over us. We are expressing a new attitude of hopefulness and confidence in the future; some say a new spirit of Americanism is being born.

• Industrially, all eyes will continue to watch the progress of the several conferences in Washington, but the work of the National Industrial Rehabilitation Sub-committee, under chairmanship of A. W. Robertson of Westinghouse, is what we of the power field must depend upon and must help the most.

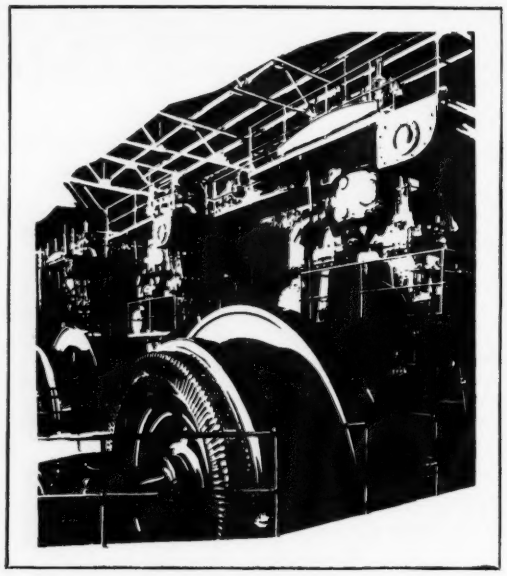
• Investigation of the probable effect of more elastic bank credits, which is here reported, has crystallized the startling truth that bank credits have little indeed to do with the lethargy of industrial executives, when it comes to the modernization of their power and steam generating equipment to reduce manufacturing expense. The findings of this investigation have already been submitted in detail to the Robertson Committee, but that does not end *Power's* responsibility.

• The Committee may, and will, do all in its power to bring about a change of attitude among the buyers. But equipment manufacturers must realize that they, also, have a duty.

• Many factory owners, with power and steam generating plants, have modernized the manufacturing facilities for their product, only to stop there in the belief that they are ready for the new business conditions. What manner of thinking is it that refuses to save the power dollars as well?

• Power machinery makers must help to overcome this unsound attitude, because they have a joint responsibility with the Robertson Committee. The time is ripe for the concentration of forces.

• Many of the industrial executives are admittedly only awaiting favorable conditions for the placing of their orders. The Industrial Rehabilitation Committee is fully organized and on the job. The manufacturers are suffering for business. Now, what is needed is cooperative action between the Robertson Committee and the manufacturers, and real courage among the industrial executives. If these can be got together, men will go back to work.



DIESEL POWER IN INDUSTRY

By OLIVER F. ALLEN
Consulting Engineer

MANY owners, plant superintendents and operating engineers are asking themselves if an oil engine will reduce their power costs and help to increase profits. There is no universal answer.

Aside from water power, which is not generally available, industrial establishments usually use oil engines, steam plants or central station supply for power and light. All three sources are equally reliable when utilized according to today's best practice. Local conditions have a great influence on relative cost of these services, and there is no general rule for their selection in any particular industry, locality or size of plant. To tell when the diesel engine fits the local conditions better than any of the others, one must consider its characteristics and limitations.

The oil engine must be compared with the steam engine, or turbine, *plus* the boiler, as it both burns fuel and produces power. Auxiliaries are of the same general order of importance as in steam plants. Water supply is simpler. Stack arrangements and provisions for avoiding smoke or other nuisances are easier to make. The diesel responds promptly to changes in load, but is inherently limited to little overload. No diesel should be operated regularly at above its conservative full-load rating, and overloads should be of short duration and generally not over 5 to 10 per cent. Consequently, in a diesel plant the combined full-load rating of all engines must equal the maximum demand plus reserve capacity. Lubrication is a function of hours of service, but little affected by load, and is zero during shut-down.

Fuel consumption per horsepower hour is influenced little by engine size. With equally good design, there is less than 10 per cent difference in fuel per b.hp.-hr. between engines of 100 hp. and 1,000 hp. and hardly 20 per cent between 50 hp. and 5,000 hp. There are much greater differences between engines of different makes and of the same output.

The best results are, with good, clean fuel, about 0.375 lb. per b.hp.-hr. (If two-cycle, include scavenging air supply in engine losses). Good commercial performance, for engines of from 100 to 1,000 hp., is from 0.45 lb. to 0.50 lb. per b.hp.-hr. Much more handicaps the plant's economicial operation. This is full-load performance at sea level, in the United States. Unlike the steam boiler, in the oil engine fuel consumption stops with the engine. Fuel per b.hp.-hr. increases very little until the load drops below half. As there is also comparatively little difference in first cost per horsepower between large and small engines, it is feasible and often desirable to put in several units, so as always to operate those in service at a good load factor and to provide maximum insurance against interruptions of service.

In this respect the diesel plant is much more flexible than the steam plant. The fact that an oil engine can be started quickly and put on the line with only a few minutes of "warming-up" also favors multiple-unit plants. In many manually controlled installations even large engines are put into service several times a day for short periods, and in the automatically controlled plants the oil engines cut in and out almost like the motors of electric household refrigerators.

Modern oil engines, especially the high-speed, lightweight types, require less floor space, less cubic building content, less foundation and simpler stack connections than steam plants. Either requires more space than the distribution and meter board of a central station service.

The depreciation and obsolescence of the oil engine are not materially different from those of the steam engine, without its boiler. Considering the plant as a whole, in industrial sizes, both items favor the oil engine.

The diesel lies between the steam plant and central station service as to attendance and the supply of auxiliary heat. The smaller-size oil engine plant does not require firemen and engineers constantly, but it does require competent, intelligent supervision and adequate, frequent cleaning. The quality of its care is a measure

of its maintenance costs. The larger plants should have the same grade of chief engineer as steam plants of like size, but do not need as much other personnel.

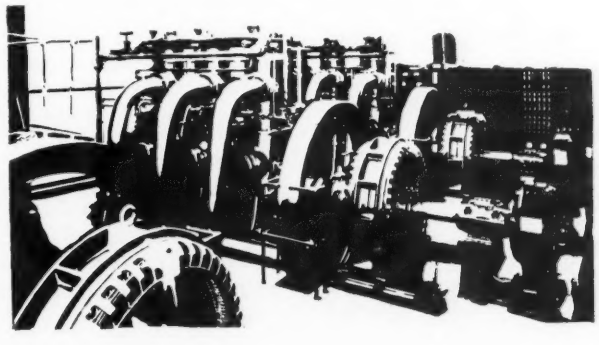
Well over half of the total heat in the fuel goes into the exhaust and the water jackets. A large part of it can be utilized, but, unless augmented by other means, it is only available at low temperatures. A generous supply of hot water can be provided, but, even with four-cycle engines and good exhaust heat boilers, very little steam can be made. Efficient utilization of waste heat from jackets and exhaust, while practiced profitably in isolated cases for many years, has only recently come into general use, and each installation must be studied by itself.

Extension of the use of oil engines and fuel oil for heating boilers has made the distribution of good, clean fuel oil quite general. It is no longer necessary for the owner of a diesel plant to provide storage capacity or to invest in fuel for more days supply than he would of coal for a steam plant.

This brings us to the heating problem in connection with the diesel plant. The rapid progress made in automatically and semi-automatically controlled heating boilers, especially those which are oil fired, has changed the whole problem of steam or hot water supply for process, building and various other heat requirements. While there are plants where the heat balance possible with a steam power plant makes the net operating cost less than it would be with either central station or other engine service, there are others where a combination of oil engines with steam or hot water heating from units designed for the purpose (and sometimes using fuel from the same tanks as the oil engines), will show lower net costs. Here the waste heat of the diesel jackets and exhaust can be utilized effectively.

To determine if a change in source of power supply, a modification or improvement in existing plant, shutting down a plant or building a new one, will produce the most profit, all things considered, the power user should know not only the power cost now, in dollars, and its relation to other plant operating costs, but what that cost includes in capital charges, general expense items, upkeep, labor and materials. And what does he get in return? What is the normal load and its duration? What are the minimum and peak-loads and their duration? What service is required for off-season and rush-season operations? What for nights and holidays? What are the heating requirements and how do they affect the power supply?

The wider the fluctuations in demand and the lower the load factor, the more reason for an oil engine installation, in many cases. This is because of the high fuel efficiency, low stand-by losses and great flexibility of the diesel plant, compared with the necessarily costly ability to meet the relatively high maximum demand which must be included in the central station charges, or the lower partial load efficiency and high fixed charges of the isolated steam plant. On the other hand, where the load and utility factors are very high, in other words, if a plant approaches full load all day and all night, every day, the high thermal efficiency of the oil engine, operating right where the power is consumed, compared with the distribution costs of the central station, which must be added to generating costs, or with the lower thermal efficiency of the relatively small steam plant, may, under certain conditions, make the diesel plant's net power cost materially lower than that of either of the others. These two extreme conditions show the importance of studying each case by itself.



The Oil and Gas Power Division of the American Society of Mechanical Engineers has for several years compiled an annual report on Oil Engine Power Cost which is a mine of valuable information on the operating results in a variety of installations. The 1931 Report covers 119 plants in the United States, totalling almost 200,000 hp. These data are available to all engineers studying oil engine plant problems.

We are prone to think of the three sources of power we are discussing as independent and competitive and to consider only central station current for reserve or breakdown service. As a matter of fact, each has its proper field and the big neutral area in which they are competitive affords many opportunities for them to work together. Outstanding examples are R. H. Macy & Co., and Harrods great department store in London.

Where there is central station service with only one feeder, or feeders from only one sub-station, or an isolated plant with only one steam boiler or engine, an oil engine may be the cheapest insurance against failure of power supply; or where the peaks and fluctuations in load are so great as to make the demand charge excessive, an oil engine may smooth out the load and reduce current rates enough to effect a considerable saving.

In some steam plants, for off-season loads, nights, holidays, etc., the installation of a small oil engine, sometimes semi-automatically controlled so the night watchman can give all the service required while the regular engine room staff is off duty, has proved a sound investment.

The results of combining diesels with steam plants, and with purchased current, where the over-all cost of power and light has been reduced to less than when any one of the three was used alone, and where the insurance against interruptions and adequate provision for heat services have been so pronounced that power users should give them careful consideration in studying how to reduce their power costs.

In making a decision the owner will necessarily consider the amount of investment, and the return on it, as well as the value of an ample supply of low cost power, all the time, without interruptions, for the operation of his plant. There are many local conditions involved in the first cost of an isolated plant, and many cases where the technical survey will indicate the economy of adding an oil engine or two to existing equipment, but it is impossible to give any general estimate of first costs. Broadly speaking, in sizes below 2,000 hp. there is little difference between steam and diesel plant cost per hp., when everything is included. For plants smaller than 500 hp., the diesel has frequently, a materially lower cost.

By D. D. EAMES

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Symmetry of the Boston Post Office shown in construction photo

THE BOSTON POST OFFICE

—A HEAT AND POWER ANALYSIS

A NEW Post Office and Federal Court House was authorized for Boston in May, 1928, and $6,000,000 was appropriated. The building has now reached the stage shown by the photograph, the contract date for completion being Feb. 24, 1933.

The information here presented summarizes the conclusions of an independent examination of the steam and power requirements of the building and their most economical sources of supply.

The Edison Electric Illuminating Company of Boston is prepared to furnish both steam and power for all the requirements of the building. It was evidently the original intention of the designers to make use of this source of supply, but the local coal interests and labor officials, bringing pressure to bear at Washington, caused a change in these plans.

The arrangement adopted, after considerable controversy, was for the Edison Co. to furnish the electric power and light, and for a boiler plant in the building to furnish the steam for heating and other uses. The Edison Co. has, however, made a steam service connection to the building, feeding into the main heating supply line. It is generally understood that Edison steam will be used until the construction work is finished, and after that the boiler plant in the building, but this is not certain, and there are some who say that the use of Edison steam will be continued indefinitely.

Occupying the entire block bounded by Milk, Devonshire, and Water Streets and Post Office Square, the new Post Office is approximately 200 by 230 ft. in ground plan. The sub-basement, basement, first, second and third stories are the full size of the building. The fourth story has a central court, and this from the fifth to the seventeenth stories extends out to the Post Office Square side. On the west side of the building a tower extends to the twenty-second story, a total height of about 305 ft. above the sidewalk. The cubical content of the building is about 10,730,000 cu.ft. Directly under the fourth and seventeenth floors are gallery floors for pipe and duct distribution. The design of the building is symmetrical about a center line running from Post Office Square to Devonshire Street, and this symmetry of arrangement has been carried even to the boiler plant, coal storage and auxiliary equipment layout for the sub-basement.

Boiler equipment comprises four 3,000-sq.ft. cross-drum boilers set in two double batteries, and fired with steam-driven side-dump stokers. The entire boiler area is in a pit depressed 9 ft. below the sub-basement floor. Each battery is served by a steel stack 6 ft. 4 in. in

diameter, and 296 ft. high above the boiler pit. These stacks are lined with fire brick to a height of 70 ft. and terminate about on a level with the nineteenth floor of the tower.

The steam capacity of the boilers is specified as 15,000 lb. equivalent evaporation from each unit continuously, and 20,000 lb. for two-hour peaks. My estimated maximum steam requirement for the entire building is 30,000 lb. per hour. Consequently, there will be two spare boilers all the time, and three spares for eight or nine months of the year. Designed for 160-lb. steam pressure, the boilers are to be operated at 100 lb. Each battery of boilers has a steel blow-off tank with an 8-in. vent extending to the main roof 300 ft. above. The feed water equipment consists of two 12x7x12-in. duplex pumps, and an open, deaerating heater having a specified capacity of 30,000 lb. per hour from 160 deg. to 210 deg.

The Edison steam entrance is a 6-in. line, feeding into the 12-in., 40-lb. heating supply main through 2½, 4, and 6-in. lines, each with regulator and variable orifice valves. On the return end of the heating system is a flash tank for receiving the discharge of high-pressure traps, and two heat exchangers for transferring heat from the returns to the domestic water supply before discharging them to the sewer.

The steam supply facilities consist, therefore, of two duplicate boiler plants, either of which is capable of supplying the full requirement of the building, and a central station service, also of full capacity. Surely this building ought never to lack for heat.

In line with the symmetrical idea, two coal storage rooms have been provided on the Water and Milk Street sides of the building in the sub-basement. Each room is about 32x68 ft. in size and about 15 ft. in clear height. Coal will be received through coal-holes in the sidewalk, but can be stored out across the room only by extensive trimming. If the rooms were filled to an average depth of 6 ft. the capacity of each would be 310 tons.

The center of each coal room is about 150 ft. from the center of the firing gallery, and around three corners; no mechanical coal handling equipment has been provided. The entire sub-basement devoted to the boiler plant, mechanical equipment, and fuel storage space, will inevitably become very dirty. The coal-firing gallery, which is level with the top of the stoker hoppers, is shown on the plans as an open grating. The boiler feed pumps, heating vacuum pumps and other equipment are not protected in any way from the dust in this part of the building.

Steam is taken off each boiler through an 8-in. lead into a 10-in. high-pressure header, from which three 4-in. leads, with regulators, supply a 12-in., 40-lb. main. This main extends the width of the building and feeds the main heating supply lines, which extend to the third and sixteenth-floor pipe spaces. The 40-lb. main also feeds the indirect heaters and humidifiers and the domestic water heaters, everything being arranged in perfect symmetry about the building center line, except the Edison connection which comes in at one end of the 12-in. main.

The heating system proper is a direct radiation system with a total of 66,900 sq.ft. of surface. Radiators are of the hot-water type with modulation valves on supply and thermostatic traps on return. There is no zoning or other effectual automatic temperature control system. In addition to the radiation, there are six unit heaters for entrance vestibules, each heater having a capacity of 80,000 B.t.u. Heating supply mains are located in the intermediate pipe spaces, with up- and down-feed risers to all floors, and supplied from the 40-lb. lines through regulators for 5-lb. pressure. All heating returns discharge to two duplex motor-driven vacuum pumps in the boiler pit, which in turn, discharge either to the feedwater heater or through the heat exchangers to the sewer, as described above.

Ventilation is provided for the work rooms in the lower floors, and for the court rooms and library in the upper floors. Exhaust ventilation is provided for the sub-basement, boiler and coal storage rooms, and for the toilets. The fresh air supply is drawn through an intake on the Devonshire Street side and filtered through adhesive filters. Humidity is provided by pan humidifiers with submerged steam coils. The fresh air fan and heater system is provided with suitable automatic control of dampers and steam valves. The humidifiers are also furnished with humidity control and temperature control of the water.

A temperature indicating system has been provided, with panel in the engineer's office in basement, to indicate the temperatures at twenty selected points throughout the building, and at four outside stations. The value of this system in the practical operation of the building is not apparent. If the engineer receives an indication of too high or too low a temperature in any part of the building, there is little or nothing he can do about it because of the way the system is laid out.

The statement was made that no effectual automatic temperature control system has been provided for the heating system. A "heat control" apparatus is specified, consisting of two thermostats located in the custodian's office on the fifth floor, each thermostat to control a motor-operated valve in the two main 40-lb. heating supply lines. I am told that the valves will open and close in 30 sec. in response to the demands of the thermostats. The criticisms of this control system are obvious. The thermostats are not in representative locations for temperature indications (even assuming that such locations could be found). Each of the valves which they control supplies about 33,000 sq.ft. of radiation having north, south, east and west exposures.

This article was prepared at the request of the editor of *Power* in line with the well-known editorial policy of the magazine, in order that the engineering facts and real economics of the Boston Post Office situation might be presented at their face value. Briefly my conclusions are that the decision for the building to generate its own steam was correct, and that if electric power had also been generated, a further reduction in yearly operating cost of about $16,500 would have been accomplished — Author.

Moreover, the operation of a quick-opening valve in a 40-lb. steam line will cause very serious strains in the piping system.

It is my opinion that the following criticisms of the layout are in order, and that these criticisms are pertinent to this paper because they are with regard to items that affect the first cost and continual operating cost of the building.

1. The general arrangement of the plant should have been worked out with more regard to practical operation and with less to symmetry of arrangement about the building center line. In particular, the location of two coal storage rooms on opposite sides of the building, each 150 ft. from the boilers, is a waste of floor space, a cause for increase of coal-handling labor, and a source of dust that may travel through a wide portion of the building.

2. I believe that oil fuel should have been very carefully considered. This is a case where oil is particularly suitable, and, while its first cost is higher, the labor saving and better furnace efficiency would have made up the difference, with the great benefit of cleanliness, both inside and outside the building.

3. Three boilers could have been used instead of four, and the plant would still have had a spare boiler all the time.

4. One chimney of the diameter and height provided is ample for the load, instead of two. The top of the chimney should be higher than the highest part of the building. The omission of one boiler and one chimney would have saved about $20,000.

5. The amount of radiation provided for the building (66,000 sq.ft.) is unnecessarily large. My computations indicate that about 52,000 sq.ft. is sufficient.

6. The automatic temperature control, as provided for the heating system, is of little, if any, value. A good system of temperature control or zoning should certainly, in my opinion, have been provided, and would save about 8,000,000 lb. of steam a year, besides affording much more comfortable working conditions.

The question now arises: Was the decision right to install and use a heating plant instead of purchasing steam from the Edison Co.? My answer to this will be based on the relative costs and savings of the two methods, as they appear from my estimates.

Table I gives the estimated monthly quantities of steam used for all services, together with the costs if the steam had been purchased from the Edison Co. as figured from the company's regular heating contract form. The coal adjustment of four cents per thousand pounds has been added as a lump sum at the end. The steam quantities include that for direct heating, unit heaters, ventilation, humidifying, and domestic water. Allowance in the steam required for domestic water heating has been made for heat reclaimed in the rubbish burners. The heating quantities have been based on average temperatures from Weather Bureau reports.

This table indicates a total cost of purchased steam of $55,000 a year, while the comparative figure for cost of generating the steam in the boiler plant located on the premises, as given in Table II, amounts to $43,400. In other words, purchased steam would cost about 26 per cent more than steam generated locally.

In the above estimate, and also in the following estimate of the engine plant, no value has been assigned to floor space occupied for power plant use, or for chimney space up through the building. In the case of the

TABLE 1—SCHEDULE OF PURCHASED STEAM REQUIREMENTS AND COSTS

Month	Steam — Thousands of Lb. Day	Night	Total	Edison Cost — Dollars Per Month	Av. per M lb.
September	1,290	150	1,440	1,370	0.95
October	3,160	260	3,420	3,055	0.895
November	5,080	2,020	7,100	5,870	0.825
December	6,660	3,680	10,340	8,185	0.79
January	7,350	4,170	11,520	9,010	0.785
February	7,350	4,160	11,510	9,005	0.785
March	6,300	2,910	9,210	7,390	0.802
April	4,540	1,390	5,930	4,995	0.842
May	2,540	150	2,690	2,435	0.905
June	150	150	300	345	1.15
July	150	150	300	345	1.15
August	150	150	300	345	1.15
Total			64,060	52,350.	
Coal adjustment at 4c. per M			.....	2,560.	
Total cost of purchased steam				$54,910.	0.855

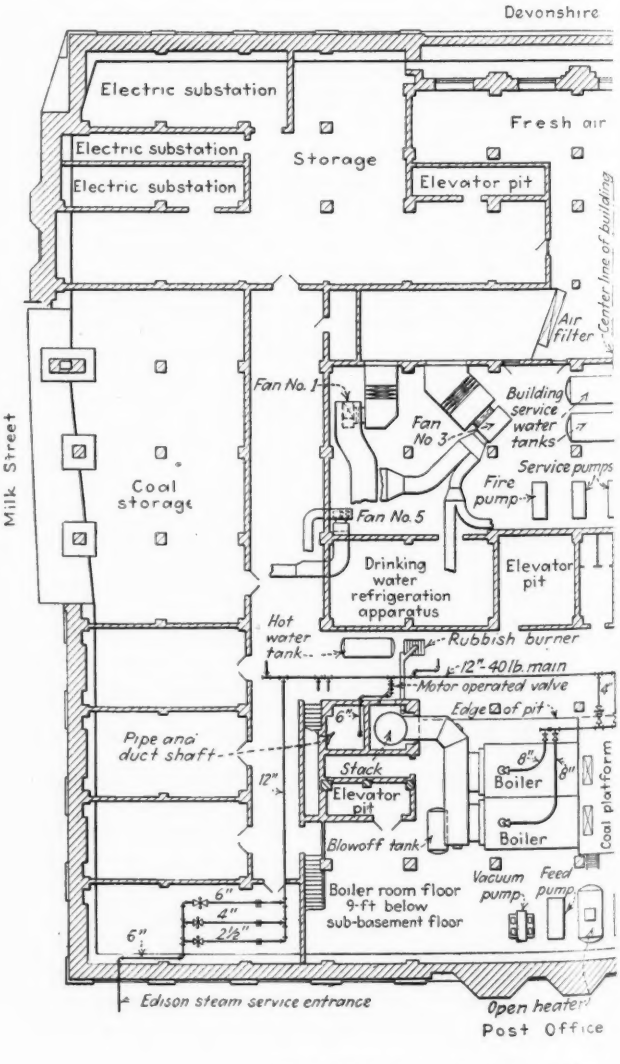
TABLE 2—COST OF OPERATING BOILER PLANT TO PRODUCE STEAM SHOWN BY TABLE 1

Coal, 3,770 tons at $6.25 per ton	$23,600
Labor — 3 firemen, 52 weeks	5,500
3 coal and ash men, 35 weeks	3,200
Boiler room supplies and maintenance	1,500
Boiler insurance	200
Water, ash removal, electric current	900
Fixed charges on $85,000 investment	8,500
Total	$43,400

Annual saving in favor of steam generated on the premises $54,900 — 43,400 = $11,500.

The investment used above includes cost of entire boiler plant equipment and an allowance for additional construction cost of the boiler pit below the sub-basement floor.

Fixed charges are taken at 4 per cent interest and 6 per cent depreciation, with no tax or insurance items.



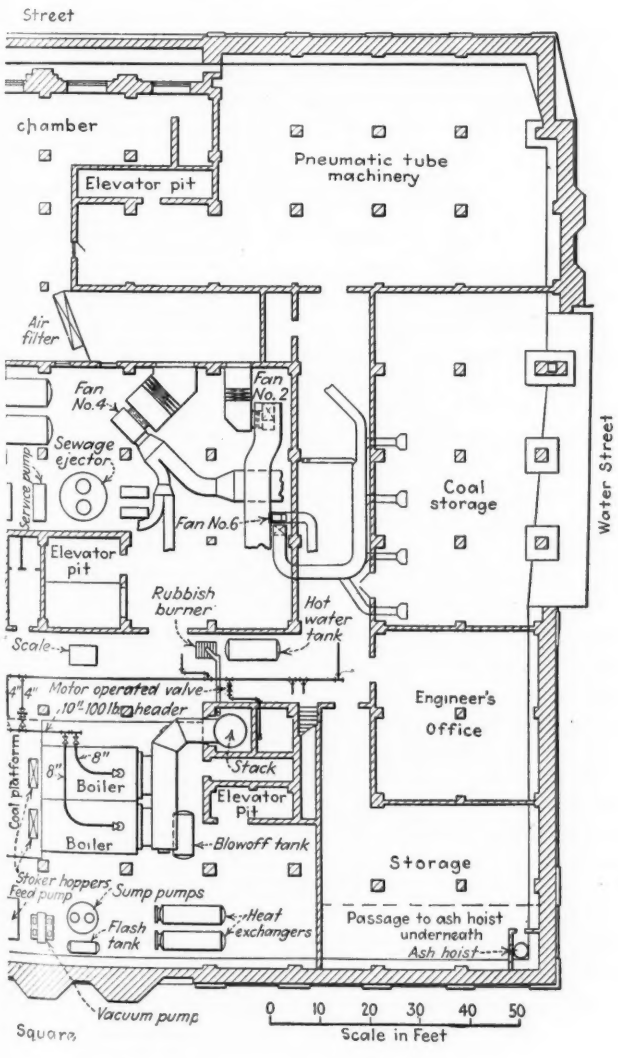
sub-basement there was evidently no intention or desire to devote any part of the area to postal work, judging from the distribution and liberal allotments of space to mechanical equipment over the entire area. In the case of the chimneys, their location at outside corners, adjacent to stairways and pipe shafts, seems to preclude the chance for any other use of the space.

The second question to be considered is: Could the Government have made a saving by installing generators instead of purchasing power and light? This would involve the installation of turbine or engine generators, with stand-by capacity, and the use of exhaust in the heating system.

The maximum demand for steam in the heating system is about 50 per cent greater than the steam requirements of engines at full building load, consequently the boiler plant as installed is of ample capacity. Steam pressure conditions are also suitable for the operation of uniflow engines, which is the type of unit considered.

Electric power requirements as furnished by the supervising architect and checked by the writer, are as follows:

Lighting	600 kw.
Motors	1,060 connected horsepower
Estimated demand	700 kw. total power and light
Current characteristics	120-208 volt, 3-phase, 4-wire, 60-cycle, alternating current.



Basement plan showing location of equipment and coal storage space

The method of attacking this problem has been to construct daily load curves for days supposed to be typical of three seasonal conditions, namely, winter, spring and fall, and summer. From these curves the total amount of steam for heat and power can be determined hour by hour for each of the typical days, and the results then expanded to cover the whole year. This method takes full account of the hourly coincidence of steam and power demands, without which no by-product power analysis can be correctly made. Space prohibits giving the curves and tables, but the results are summarized in Table 3:

TABLE 3—TOTAL STEAM REQUIRED FOR GENERATION OF ALL HEAT AND POWER, KW.-HRS. USED AND COST IF PURCHASED

Month	Steam for Power and Heat M Lb.	Kilowatt-Hours	Cost of Power if Purchased
September	4,580	143,000	$3,464
October	6,746	164,000	3,667
November	6,746	164,000	3,667
December	11,713	204,000	4,045
January	11,713	204,000	4,045
February	11,713	204,000	4,045
March	11,713	204,000	4,045
April	6,746	164,000	3,667
May	6,746	164,000	3,667
June	4,580	143,000	3,464
July	4,580	143,000	3,464
August	4,580	143,000	3,464
Total	92,156	2,044,000	$44,704

Average cost per kilowatt-hour, $0.0219.

Edison power costs are figured on the basis of the "General Wholesale Rate *D*," dated June 1, 1931, and using the low-tension rate with special application to the alternating current network in the direct-current district.

For engine-room equipment, I have considered the installation of vertical uniflow engines, two of 500-kw. capacity each, and one of 250-kw., together with switchboard and wiring, piping and insulation, oil purifier and tank, engine foundations and engine room ventilation. The estimate for this equipment totals $102,000.

We now have all the data for making final comparison of the costs of the three different schemes for supplying the building with its steam and power requirements. This comparison, Table IV, shows that if steam and power were both purchased, the yearly cost would be $99,600. If steam is generated and power purchased—this being the plan for which the building was designed—the cost would be $88,100. If the building had been made completely independent of central station service, the total yearly cost would have been $71,800, with an annual saving over the proposed scheme of about $16,500.

TABLE 4—COMPARATIVE YEARLY COST FOR ALL STEAM AND POWER—DOLLARS

	Original Plan. Steam and Power Purchased	Accepted Plan. Steam Generated Power Purchased	Proposed Plan. Steam and Power Generated
Purchased steam	54,900	.....	.....
Purchased power	44,700	44,700	.....
Coal	.....	23,600	33,300
Labor — boiler room	.....	8,700	10,200
engine room	.....	.....	5,500
Boiler room maintenance	.....	1,500	1,500
Engine room maintenance	.....	.....	1,000
Insurance	.....	200	400
Water, ash removal, etc.	.....	900	1,200
Fixed charges	.....	8,500	18,700
Total	99,600	88,100	71,800

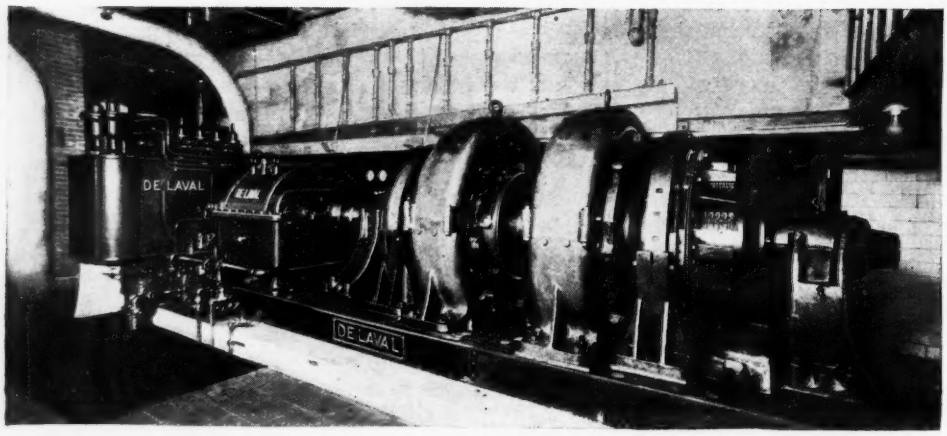
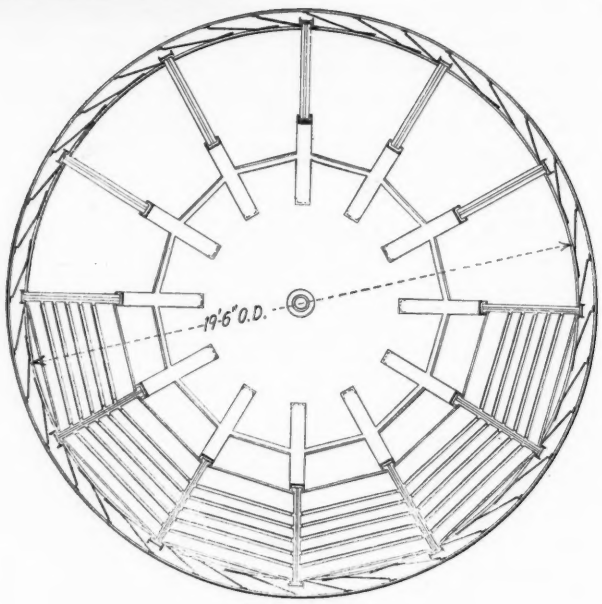


Fig. 1—Geared 1,000-kw. condensing turbine bleeds for heating

Fig. 2—Air moves into cooling towers through tangential louvers and spirals to the center, throwing out entrained water



Section C-C

CONDENSING TURBINE, SPRAY-PROOF TOWERS MAKE NEWS IN NEWARK, N. J.

By GEORGE H. GIBSON
Consulting Engineer

Power for production of Newark Evening News furnished by 1,000-kw. turbine exhausting at 29-in. vacuum and bled for building heating. Circulating water cooled in new type of roof tower designed to eliminate spray nuisance. Coal consumption reduced nearly 50 per cent under old Corliss plant.

▼

THE low costs at which power can be produced where steam is also required for process and heating purposes are quite generally appreciated, particularly by those engaged in industries where much low-pressure steam is used throughout the year. Where low-pressure steam is needed principally or solely for heating and the engines or turbines must exhaust to atmosphere during a considerable part of the year, the "by-product power" argument may however be thought not to apply. The capacity of low-pressure boilers and simple engines, which may have been installed years ago, has in many plants been outgrown, so that the choice must be made between modernization and the purchase of power and possibly also of heat from the outside. In making comparisons as the basis of such choice, however, full consideration should be given to recent developments, including higher boiler pressures, improved methods of combustion, more efficient turbines and engines and, finally, vacuum condensers supplemented by cooling towers of improved design.

The power plant of the Newark (N.J.) *Evening News* serves to illustrate all of these points. In 1908, four return-tubular boilers of 1,500 sq.ft. each were installed to supply steam at 150 lb. gage to two Corliss engines exhausting to the heating system and to atmosphere and driving 165-kw. generators, constituting a duplicate plant as required for continuous newspaper service. Engine and boiler rooms are below street level, coal being stored in bunkers under the sidewalk.

When the load increased later on, a 300-kw. Corliss-engine-driven generating set was installed. However, as three boilers were then required to carry the peak loads, it was decided (in order to provide a duplicate plant) to install larger boilers of the water-tube type with mechanical stokers.

The four original boilers have now been replaced by two water-tube boilers of 5,000-sq.ft. surface capable of operation at 200 per cent rating. These are designed to generate steam at 240-lb. pressure with 100 deg. F. superheat. At the same time, the 4-ft. diameter, 100-ft. high steel stack was moved to a new location and a new

radial brick stack built around it. The old stack was then cut to pieces and removed through the soot door at the bottom, all of this work being done piecemeal during a few hours on Sundays, the only time when the plant was shut down, as all editions of the paper continued to be gotten out on time as usual.

To bridge over the gap until space could be made for the installation of a larger turbine, a 400-kw. non-condensing turbine was installed in one corner of the engine room. Later, through the installation of high-speed presses in place of some of the low-speed presses, it became possible to take over additional basement space. In this a 6-stage, 1,000-kw. turbine was placed.

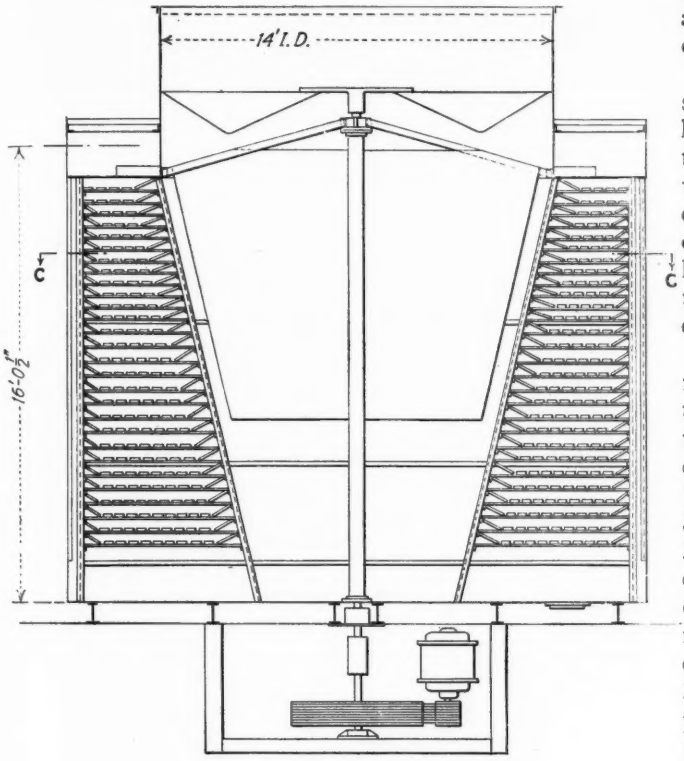


Fig. 3—Vertical section of tower showing discharge fan and motor

This turbine which was built by the De Laval Steam Turbine Co., has automatic nozzle control and turns at 6,000 r.p.m. When operated under full load and straight condensing, it is guaranteed to have a steam consumption not to exceed 16¾ lb. per kw.-hr. generated, based on 28-in. vacuum and 80-deg. water. This rate includes steam taken for the operation of the steam-jet air pump, the condensate pump and the motor-driven circulating pump. When bleeding 10,000 lb. of steam at 2 or 3-lb. gage pressure, under which condition 10,700 lb. would go to the condenser, the turbine is guaranteed to use not more than 20.7 lb. of steam per kw.-hr.

It is connected by a double helical speed-reducing gear to tandem Crocker Wheeler generators running at 720 r.p.m. These are so wired that at some future date current may be distributed, if desired, at 240 volts, using the 3-wire system. The circulating pump, also supplied by the De Laval company, has a dual drive, consisting of a turbine at one end and a motor at the other, and is designed to deliver 2,300 g.p.m. against 50-ft. head, including all friction.

The boiler feed pumps receive steam at 235 lb., but the other steam auxiliaries and the Corliss engines, which were left in place as a duplicate generating plant, receive steam at 135 lb. per sq.in. through reducing valves and a desuperheater. Saturated steam is also supplied to steam tables at 100 lb. To supply cooling water for the condenser, two cooling towers, built by James M. Seymour, Inc., East Orange, N. J., were placed on the roof of the building about 180 ft. above the condenser, water being carried to and from the towers by 14-in. lines.

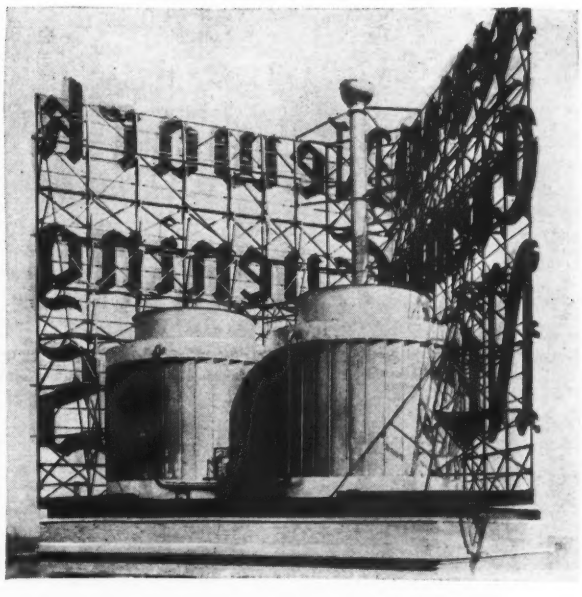
As the Newark *Evening News* building is located on Market Street in the most congested part of Newark, any tendency to spray from the towers would have been an intolerable nuisance. This is avoided by the design of towers selected.

As shown by the accompanying horizontal and vertical sections, air is admitted to the tower through tangential louvers and is then drawn upward through the center of the tower and discharged by a fan mounted upon a vertical shaft, driven by a motor at the base. Through conservation of "moment of momentum," the air as drawn inwardly acquires an increasing velocity of whirl, like water running out of a wash basin. This serves to throw any entrained drops of water back onto the circumferential trays or baffles.

The motor speed is controlled by armature and field resistances, the point of full field current with no controller resistance in the armature circuit corresponding to 126 r.p.m. of the fan and to the delivery of 180,000 cu.ft. of air per min., at which load the motor takes 13 kw. At maximum speed, the motor consumes 36.5 kw. and drives the fan at 169 r.p.m., circulating 255,000 cu.ft. of air per min., as might be required to carry the load with 75-deg. F. wet-bulb temperature and only one tower in use. The spray loss at this rating is not visible even under winter conditions. With a water capacity exceeding 2,000 g.p.m., each tower releases 250,000 B.t.u. per min., giving a total capacity for the present two towers of 1,400 kw. There is space on the roof for an additional tower if it should be required.

The towers measure 20 ft. 7½ in. in diameter and, with the water, weigh 40 tons each. The unbalanced

Fig. 4—Two towers mounted on roof of Newark Evening News building



water lift is 14 ft., and, due to the use of large piping, the friction head on the circulating pump is small. The towers are blown down once a week, the make-up being obtained from the deep-well water tank. After deducting the theoretical evaporation, the spray loss figures out as practically nothing.

Simultaneous vacuum gage and recording wattmeter charts for a typical day's run show that a vacuum of 29 in. or over is held by the Foster-Wheeler condenser through the sharp peaks typical of a newspaper load.

The condenser hotwell pump discharges into a Cochrane combined deaerating and storage heater, wherein the condensate, together with heating system and other uncontaminated returns and make-up water from the city mains, is heated to 212 deg. F., or above by the exhaust of the steam-driven auxiliaries, supplemented by bled steam if necessary.

These steam-driven auxiliaries include the boiler feed pumps, which receive high-pressure steam, and Westinghouse air-brake compressors, sump pump, heating-system vacuum pumps, stoker engines, forced-draft engines, hot-well pumps and steam jets, all of which use steam at reduced pressure. Electric auxiliaries include a motor-driven compressor, the condenser circulating pump, the Pomona deep well pump and tower fans.

Flowmeters register steam produced by the boilers, steam consumed by the main turbine, circulating water and process steam. The following figures relate to the 24 hours covered by the charts mentioned.

Total steam produced	165,000 lb.
Total steam for process and auxiliaries	61,000 lb.
Steam used by turbine	104,000 lb.
Total energy generated	7,020 kw.-hr.
Average steam per kw.-hr.	14.8 lb.
Coal used	17,369 lb.

For comparison, the performance of the former engine and low-pressure boiler as given by an average of 21 days of 24 hours each, is:

Total steam produced	267,000 lb.
Total steam for process and auxiliaries	72,000 lb.
Steam used by engines	195,000 lb.
Energy generated	5,247 kw.-hr.
Steam per kw.-hr.	37.1 lb.
Coal used	28,150 lb.

In other words, the use of higher steam pressure and a condensing turbine has reduced the steam consumption per kilowatt-hour by over 50 per cent as compared with low-pressure steam and Corliss engines, even

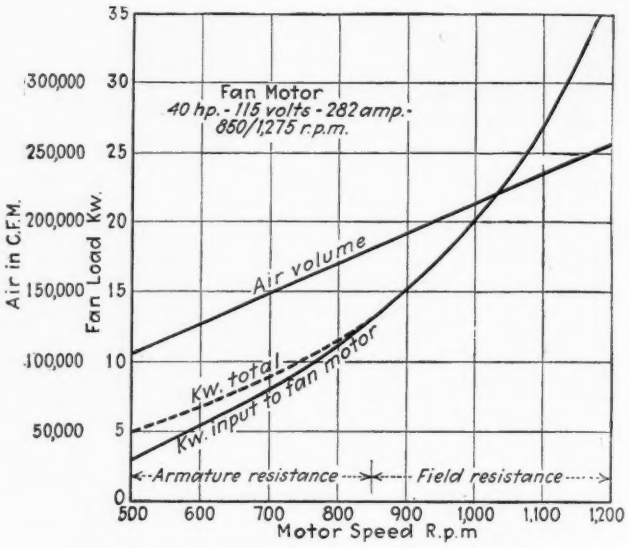


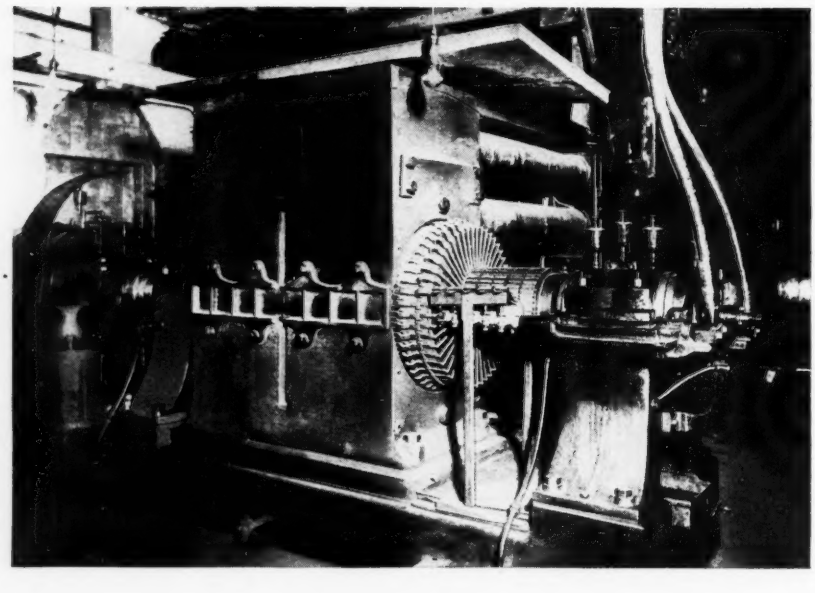
Fig. 5—Operating characteristics of cooling-tower fan

though the average load factor for the turbine day's run which is taken for comparison is only 29 per cent.

Had business conditions continued as at the time when the recent changes in the power plant were planned and made, a much higher load factor would be shown, and eventually it will probably be necessary to provide still greater capacity. The 300-kw. engine set will then be removed to make room for a 1,400-kw. turbine, while the present 400-kw. turbine, rebuilt to run condensing, will carry night and off-peak loads.

It may also be necessary to install another boiler, which will give a complete duplicate power plant of 1,400 kw. or 2,800 kw. altogether, all without requiring any additional floor space except to remove one of the present presses to make room for the additional boiler. This can readily be done when another high-speed press is installed. The total floor space now occupied by the power plant, including the coal bunkers, is about 4,600 sq.ft.

The original design and the modernization of the Newark *Evening News* power plant have been carried out according to the plans and under the direction of Henry D. Scudder, Jr., consulting engineer, Newark, N. J.



FIRST EDISON JUMBO

This first Edison Jumbo dynamo went into operation in Thomas A. Edison's first central electric light plant, New York's historic Pearl Street station, the fiftieth anniversary of which was celebrated Sept. 4. It is now in Henry Ford's Museum of American Industries at Dearborn, Mich., having been given to Mr. Ford by The New York Edison Company, successor of the Edison Electric Illuminating Company, the pioneer company of the Edison system of incandescent lighting. This is the only one of the six dynamos with which the station was originally equipped that is still in existence.

A proper balance between power load and process-steam requirements must be maintained in many industries if production cost is to be kept at a minimum. Several means of doing this automatically are here described

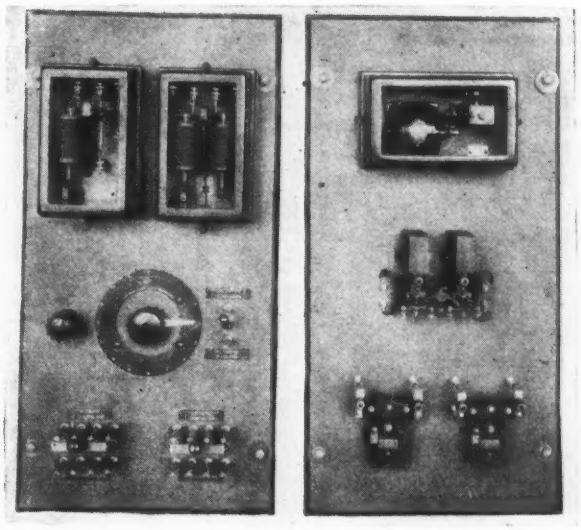


Fig. 1—Steam-turbine load-regulator panels for a sugar refinery

AUTOMATIC REGULATORS AID PROCESS-STEAM PRODUCTION

By F. A. BYLES
General Electric Company

MANUFACTURERS requiring large quantities of process steam at low or medium pressures have found it not only practical, but profitable, to obtain a portion of it from the exhaust side of one or more of their prime movers which furnish their industrial power. In other words, an engine or turbine is interposed between the high-pressure and the low-pressure sides of the steam system.

Steam-turbine designers have made a special study of the many commercial applications of the steam-turbine relative to steam requirements of manufacturing processes. The necessity for steam at more than one pressure brought out the mixed-pressure and automatic-extraction turbines. Steam-pressure regulation, and in many cases a combination of speed and pressure regulation, required governor mechanisms of special design. These requirements have been met, and today it is possible to obtain industrial turbines equipped with variable-speed oil governors, constant-pressure governors and various devices for special regulation and protection.

In order to use process steam from a turbine at constant pressure, the turbine must drive a machine or electrical generator whose power output can be controlled to suit the steam demand. A turbo-generator set operating under the control of a back-pressure regulator should usually be connected to a system having a capacity which is at least equal to that of the back-pressure regulated machine.

The mechanical back-pressure regulator is used to shift the load between the back-pressure controlled machine and the system it parallels in order to accommodate the demand for low-pressure steam.

In many instances, electrical regulating and protective equipment operates with the mechanical back-pressure regulating equipment. It is the purpose of this article to describe the salient features of several electric regulating systems, from the viewpoint of their being adjuncts to systems furnishing process steam. Mechanically operated back-pressure regulators are frequently required, but are not here described. The following questions may prove helpful when designing a system from which process steam is to be taken:

1. Will the electrical portion of the system be large enough to allow a given prime mover to deliver the desired quantity of process steam?

2. Will the electrical demand be limited to a definite minimum?

3. If power is being purchased from an outside source, will there be a possibility of reverse power at any time, in order to accommodate the system to a given demand for process steam? If so, can arrangements be made with the outside power vendor to absorb the excess power?

4. Will there be a possibility of overloading the generator driven by the turbine furnishing process steam?

5. Will variable frequency caused by varying steam demand affect manufacturing processes, when not tied in with a larger electric system?

6. If a portion of the electric power is to be purchased, will it be necessary to regulate the process-steam demand to suit the electric-power contract?

7. Will there be mechanical or electrical processes which may be stopped and started when desired to accommodate the process-steam requirements, and, if so, must automatic means be provided?

8. What degree of regulation is necessary to suit the general requirements?

The answers to these questions will largely determine the necessity for various regulating and relay devices.

The accompanying elementary diagrams illustrate arrangements of relay and regulating equipment. Each diagram is shown in simple form so that the principle of operation may be easily grasped. Each may have a number of modifications. For the sake of simplicity of illustration, switches, circuit breakers, instruments and standard type relays have been omitted.

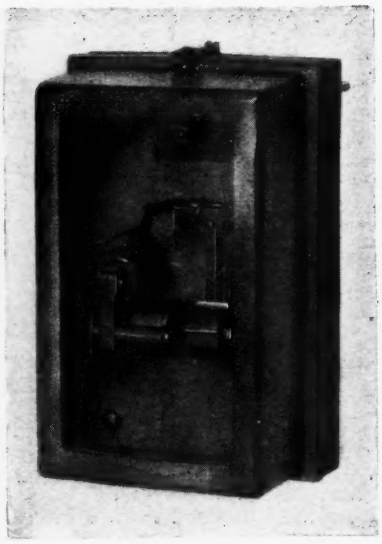


Fig. 2—Notching relay

Illustrative of how electrical regulating and protective equipment may be applied in a particular case, Fig. 3 shows a combined process steam and power system. Turbine *T*1 furnishes a certain amount of process steam, which at times may be reduced suddenly. Constant-current output is desired from the alternating-current generator *G*1. Current from this generator is absorbed by the power system, which is also fed by generators *G*2 and *G*3. The contact-making relay *CR* regulates the current output of generator *G*1, transferring the current to and from generators *G*2 and *G*3 as required.

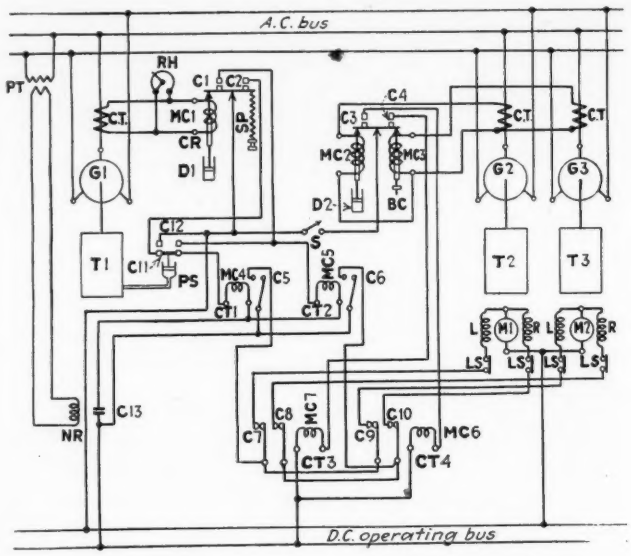
Relay *BC* balances the current transfer between generators *G*2 and *G*3. This relay operates in conjunction with the contactors *CT*3 and *CT*4 so as to prevent a continued unbalanced condition. It prevents the most heavily loaded generator from taking more current from generator *G*1. At the same time relay *BC* prevents the generator carrying the least current from shifting any further load to generator *G*1, until a balanced condition exists.

It will be noted that raise and lower contactors *CT*1 and *CT*2 have one side of each magnet coil, *MC*4 and *MC*5, connected to the contacts on the pressure switch *PS*. As long as the process-steam pressure remains below the predetermined point, the current output of generator *G*1 is held constant. If the process-steam pressure rises, contacts *C*11 on the pressure switch open, preventing contactor *CT*1 from closing, and thereby prevent further lowering of the current from generators *G*2 and *G*3, in so far as current transfer from generator *G*1 is concerned. If the process-steam pressure continues to rise, contacts *C*12 close, which in turn closes contactor *CT*2, raising the current output from generators *G*2 and *G*3, and decreasing it from generator *G*1 and also reducing the process-steam pressure. The Telechron motor-operated relay contacts *C*13 provide notching or anti-hunting action of the contactors *CT*1 and *CT*2, and thereby prevent hunting between generator *G*1 and generators *G*2 and *G*3. One of these notching relays adapted for 110-volt, 60-cycle service, and notching four times each minute, is shown by Fig. 2.

Fig. 1 shows panels for producing the regulation just described, and is similar to that in the elementary diagram, Fig. 3.

When power is purchased, it is frequently desired to hold the amount obtained within close limits. At the same time it is necessary to prevent overloading the turbine-generator used as the regulating medium, which is in parallel with other engines or turbines giving process-steam service. The elementary connections for such a system are given in Fig. 4. The contact-making wattmeter *W* is connected to the incoming line. Contact notching is provided by contact cam *CC* which is operated by motor *M*1. Contact holding effect is obtained by coils *H*1 and *H*2.

Contactors *CT*1 and *CT*2 are used between the wattmeter contacts and the turbine valve-gear operating motor *M*2. Current-limiting relay *CR* has its contacts *C*6 connected in series with the raise or valve-opening side of motor *M*2. As long as the current output of generator *G* remains below a predetermined limit, contacts *C*6 remain closed, and the contact-making wattmeter has con-



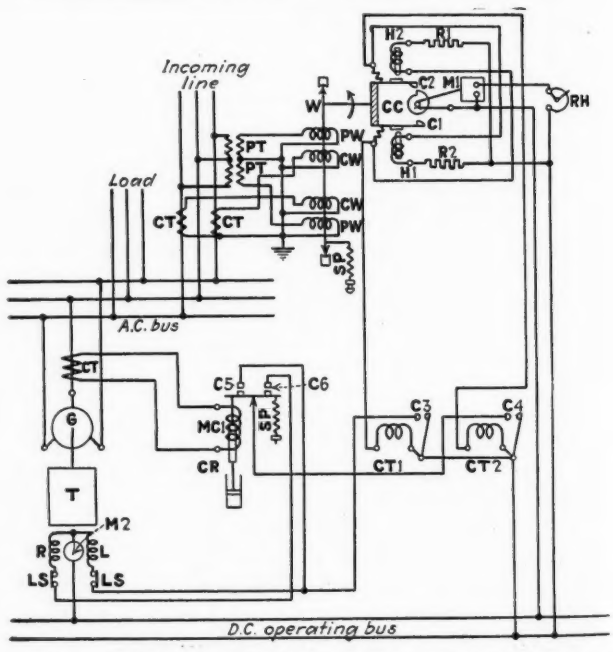
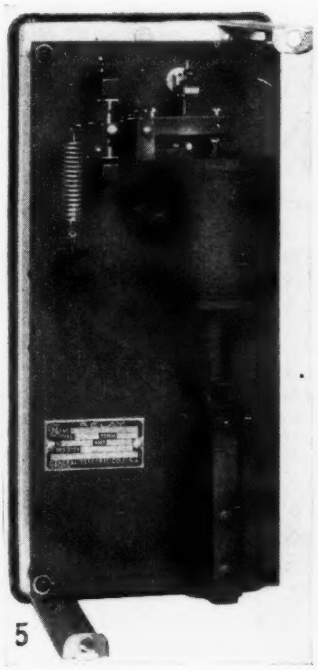
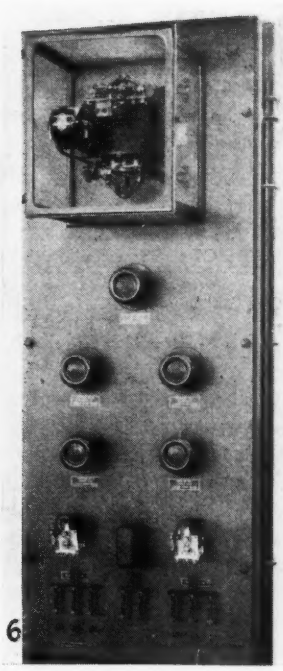
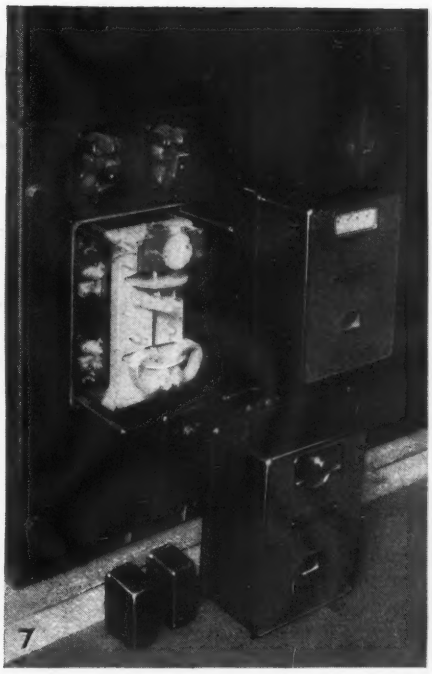


Fig. 3 (Top)—Diagram for current and low-pressure turbine control. Fig. 4—Diagram showing automatic load regulator combined with a current limit relay







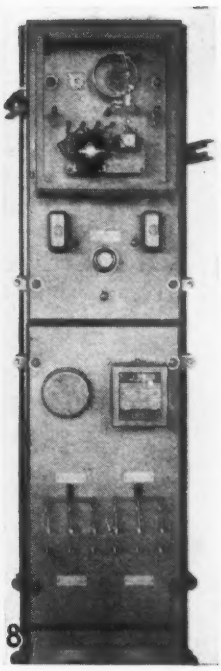


Fig. 5—High- or low-current relay CR, Fig. 4. Fig. 6—Load regulator at top of panel similar to W, Fig. 4. Fig. 7—Power relay shown with its cover removed and a watt-hour meter. Fig. 8—Regulating panel for holding constant steam pressure.

trol of the valve-operating motor *M2*. However, when the current output reaches a certain value, contacts *C6* open and prevent the valve motor *M2* from operating on the raise side. If the current output of generator *G* continues to rise, contacts *C5* close and connect into the circuit the lowering winding of motor *M2*. In other words, the current relay *CR*, Fig. 4, acts as a safety limit for the output of generator *G*. By means of a simple signal device attached to relay *CR*, the operator may be warned of abnormal load conditions before the peak-load time limit is reached.

A high- or low-current relay *CR*, such as described above, is shown in Fig. 5, and Fig. 6 is a load regulator similar to *W*, Fig. 4, for use with two turbine generators. In Fig. 6 the upper rheostat is used to adjust the speed of the contact-notching motor. The four lower rheostats are for the raise and the lower field circuits of the two valve-gear control motors. They provide a means of balancing the load between the two generators.

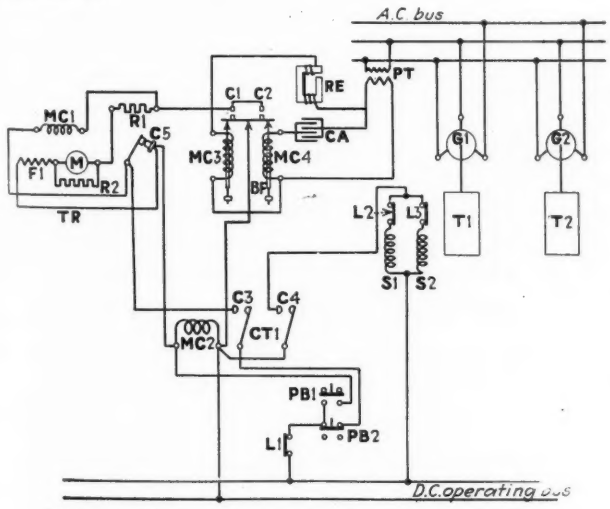


Fig. 9—Elementary connections for a frequency relay to trip two solenoid-operated valves

When a combined notching mechanism, such as included in the load regulator Figs. 4 and 6, is not required, a power relay known as Type *IG*-102 may be used. One of these relays is shown by Fig. 7 mounted on a panel with its auxiliary contacts and a watt-hour meter. When a separate notching device is required, one similar to *NR*, Fig. 2, may be used.

A pressure regulating panel, designed to hold constant steam pressure on a battery of waste-heat boilers, is shown by Fig. 8. The general arrangement of connections is similar to Fig. 4, with the exception that a pressure-control element is substituted for the watt-meter element, and a frequency-limiting relay instead of the current relay *CR*. The two switches at the lower end of the panel provide a means of transferring the turbine generators to and from the pressure regulator.

In some process steam and other installations, it becomes necessary to use a frequency-limiting relay in connection with one or more turbine generators. Such a relay may be used as a simple signaling device, or arranged to regulate or trip solenoid-operated valves.

The elementary connections for a frequency relay used for tripping two solenoid-operated valves are shown by Fig. 9. The frequency relay *BF* is of the balanced coil type. Both coils are connected to the potential transformer *PT;* coils *MC3* being connected in series with the inductance *RE* and coil *MC4* in series with the capacitor *CA*. Approximately one per cent change in frequency causes contact *C1* or *C2* to close, which energizes the timer coil *MC1* and motor *M*, de-energizing the contactor coil *MC2*. Contacts *C3* and *C4* then open, which trip the solenoid coils *S1* and *S2*, and opens the seal-in circuit of timer relay *TR*. The push-button stations *PB1* and *PB2* provide a means for resetting the system and also for tripping it manually when so desired.

It is possible in an article of this length to cover but a few of the many arrangements. However, a study of those shown will give a general idea of the many possibilities with regulating and relay equipment of these types.

CENTRAL AND ISOLATED POWER GENERATION

Power's position with respect to central or isolated power generation is founded upon the economics of power production in its broadest sense. Each has a legitimate field which will be determined by "old man economics," and no one else, and each is here to stay

By ELY C. HUTCHINSON*
Editor of Power

WHAT I say shall have to do, not with the pros and cons of utility or isolated power, but with the broader subject, namely, the economics of power generation and utilization. This is the objective, the star to which *Power* the magazine has always hitched its wagon. Moreover, I firmly believe that all who will permanently succeed must do likewise.

To the extent that utility or isolated power fails to recognize and abide by the economics of power generation, each will find its house is built upon the sands.

Isolated power was here before central power. Largely because of the lack of unity and market demand, progress of the art, at that time, was slow. Then the economical considerations brought about a centralized control of isolated groups.

What Happened

The many beneficial results and almost instant success of centralized power is proof that it was needed. Its subsequent growth and the development of its technology are among the finest records of a generation. In the sweep of progress several things of economic influence happened:

1. Many of the old time isolated plants, unable to compete with the new order, were closed out and the time-honored chief engineer was put on the shelf.

2. A sense of competition, even animus, grew out of this situation until the old-time operating man came to regard the central plant as a natural enemy. From this grew a determination of the operating man to educate himself to the higher competency required by the new order.

3. Simultaneously, consulting engineers began applying to the isolated plant the improvements mostly initiated by the central stations.

4. Meanwhile the central stations, under protection of state regulation and the established right to earn a reasonable return on capital investment, extended their operations by means of long transmission and interconnections to include outlying districts. These operations were not always economically justified. It should be noted, however that, in this, the central stations were not always the aggressors but acted under pressure and at times even under compulsion. But the result economically was the same.

5. Gradually the spread of territory came in many cases, to the definite point of diminishing returns. Where this has happened, the central stations have encountered a stiffened competition from isolated power plants.

6. Other limitations to load-growth come from large industrial establishments, which in themselves form a power concentration that economically permits them to set up plants, wherewith to generate power on their own account and save to themselves the business profit otherwise paid the central stations.

7. Leaving aside the questions of public ownership or private ownership, there do exist cases where isolated municipal plants are economically justified in remote communities, although these same communities may, upon further growth, economically justify connection into central system networks.

8. There are cases, even in the heart of territory served by central power, where conditions of load and variety of power services economically justify isolated plants as long as present rates for power prevail.

These then, are some of the factors which postulate the situation prior to the start of the new phase, which commenced in the fall of 1929. There were of course other influences, but all are related in one way or another to the cases I have named.

Municipal Plants

Consider in particular the municipal power plants: About the year 1920 the zenith in number of installations was reached and a decline set in. This was due in part to improved technology and more favorable rates in the field of central generation and distribution, and also to the business policy of the public utilities interested. In a large number of cases, however, the basic economics of power production (sometimes with other influences), has prevailed to keep the municipal plant in business. Where this is the case, those plants remaining have increased their output, so that there has been an ever mounting growth of horsepower generated despite the decrease in plant numbers.

From 1920 to 1925 the drop in number of municipal power plants was comparatively rapid. The rate has tapered off, however, during the years 1925 to 1930.

And Diesel Engines

Throughout the process there has been evidenced an increasing popularity of diesel engines and steam turbines as prime movers. There is a prevailing idea among utilities that diesel engines are primarily responsible for

*Excerpts from an address delivered at the Annual Meeting of the Pennsylvania Electric Association, Sept. 7-9, 1932.

the improved economy of municipal plants. This has, in fact, grown to the point where the diesel has come to symbolize, to the utilities, all that is undesirable in municipal plant competition. Yet, the steam turbine figures more prominently in the growth of municipal plant output than does the oil engine. Why then do many utilities indulge in the luxury of damning the diesel to the point where they even refuse to use it, while permitting the steam turbine to go free of a similar curse? Obviously there is no sound economic reason in one case, any more than the other. I know of one case where the prejudice was carried to the extent of bitterly arraigning a publication because it accepted an advertisement for a reputable diesel engine.

This is no way to meet the competition of the diesel engine. The only way is to use it yourselves when sound engineering demands.

Present signs point to increased activity in the construction of municipal power plants, by reason of the relatively high credit of municipalities and the tax-free feature of their bonds. No less than fifteen cases of recent purchase, some for additions to plant and some new, have come to my attention in the last thirty days.

Isolated-Plant Growth

Coming now to the isolated industrial plant: It has been evident for a good many years that central station power, despite a phenomenal growth, has gained little, if any, on the normal economic progress of isolated power. About 1916 the curve of isolated power production, as indicated by sales of electric motors to industrials operating on their own power, took a decided upward turn. It has maintained this direction ever since. Latest census reports show a steady growth in motors driven by industrially generated power from 6,968,950 hp. in 1919 to 12,376,376 in 1929.

One reason for this lies largely in the amalgamation of industries into larger units which in themselves possess all the characteristics necessary to the economical production of their own power. Frequently they are large users of process steam, to which power generation is a logical byproduct. Such organizations are large enough to employ their own engineering staffs, and are managed by executives educated to make unprecedented decisions based upon logically assembled facts. The technology involved is largely the product of central station development itself.

Obviously, given the capital, brains, equipment and the use for it, large industrials can make power as cheaply (or very nearly so) as many utilities and can distribute it to themselves for less than the power company can. What economic ground is there, then, for buying it?

What the larger industries are doing is true also of the smaller ones, albeit on a lesser scale. The same thing is true of isolated-plant operation in hotels and office buildings, hospitals, public buildings and other institutions requiring heat and power. Of course, each case is individual and requires special analysis, but, through all, "old man economics" will surely prevail.

Under the present conditions, that is to say since the fall of 1929, things have happened to strengthen greatly the favorable position of isolated power production.

New Equipment, New Ideas

Manufacturers of power-plant machinery have not been slow to recognize that the falling off of central station load during the late depression has decreased the normal likelihood of much new business from that source for some time. They have consequently turned their attention to the more immediately promising field—the isolated plant.

New equipment and new ideas, to make the small plant better, are rapidly coming into the market. This can have only one result: the improved position of the isolated plant as a power producer.

Up to the present, there are comparatively few cases where utility and isolated power plants—municipal, industrial or institutional—are doing a cooperative job in the exchange of power. But where they are, most examples have fully satisfied expectations on both sides.

There are other cases not in the cooperative class, where, if economy were the only deciding factor, the utility would not receive the contract. Then again, there are instances where industries have been eminently successful in making good contracts by preparing to make their own power and allowing evidence of this intention to become known to the utilities. There are also occasions where stiff-necked opposition to utility power has resulted in isolated plants being built where the economies were not sound.

"Old-Man Economics"

Through it all, one who sees both sides cannot fail to recognize executive efforts to inject some decidedly uneconomic, and at times even coercive, policies into situations which, in my opinion, would be different were there a wholesome recognition of the fact that isolated plants cannot be made to succumb to any other than "old-man economics."

Each case is a separate study to be made by engineers on each side with only the highest ideals in mind. Each should be determined to arrive at the facts and, when these are found, to make the decision automatically, on its merit.

I know of places where this was done, and the utility, in a very sportsmanlike manner, withdrew. The company policy gained great strength in the territory as a result.

On the other hand, I know of cases where utility-made analyses of competitive cases have been so biased as seriously to react against them. The day has gone in which power figures are a mystery to most prospective power users, or their representatives. Economic merit of the service is coming to be of greater weight than magic calculation or technically unsupported influence.

Isolated power today has as good professional engineers at its command as most utilities, because many have been utility trained. Manufacturers of power equipment, faced with a period where new utility business will not support them, are turning to isolated plant equipment to keep their factories going.

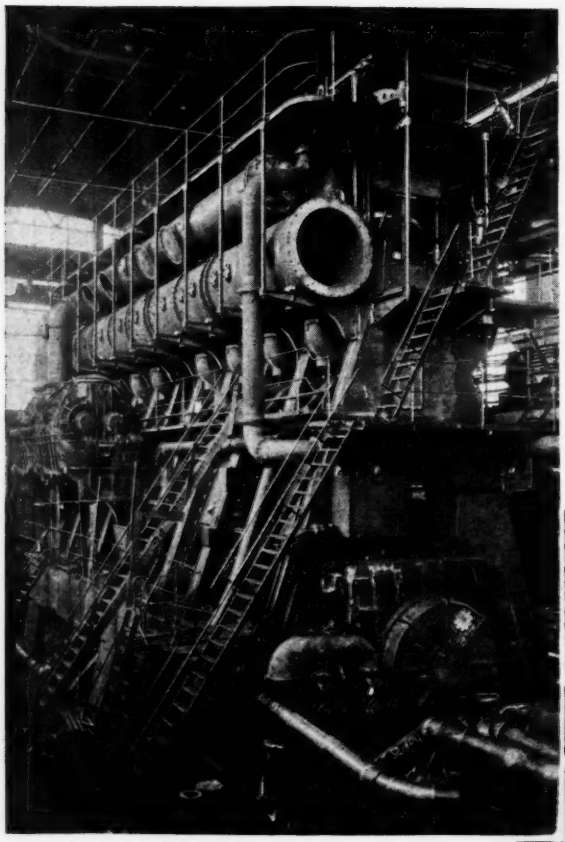
Nothing necessary to economical steam and power generation is denied the isolated plant today.

Conditions, in the way of financing, availability of graded fuels, high-pressure boilers, extraction type turbines with favorable steam rates, automatic control and operating devices and so on, were never so propitious as now.

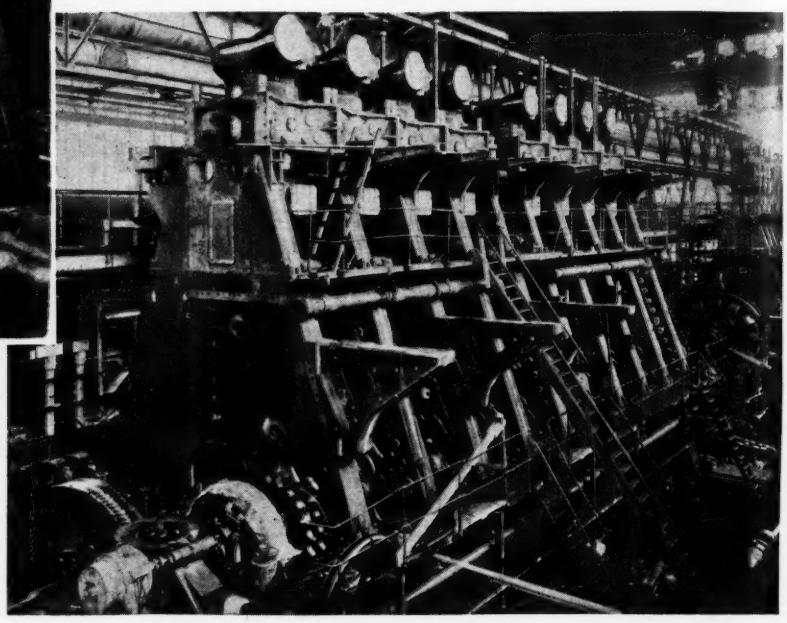
The whole situation, from the utility viewpoint, demands a fresh consideration of major policies, and their readjustment based on the inevitable conclusion that the isolated plant is economically justified. And, unless its present economy undergoes some fundamental change, it will continue to be built.

WORLD'S LARGEST

How large can the diesel be built economically? Should it be considered seriously in large station design? In an effort to answer these questions *Power* describes the 22,500-b.hp. diesel just completed for Copenhagen, Denmark. Its builders claim highly economical production, propose a 40,000-b.hp. unit.



The completed 22,500-b.hp. engine for the City of Copenhagen



This construction photograph shows the 33-in. cylinders and other elements of the design

ONLY a few years ago, it was assumed that the oil engine would never be able to compete for high power outputs, first because it did not lend itself to manufacture in high outputs, secondly because the cost would be greater than that of a corresponding steam plant. The Vernon (Calif.) diesels of 7,000 b.hp. are America's largest. Lately however, some fairly big oil engines, coupled to alternators, have been built for use in European power stations, mainly to take the peak load. Examples are to be found in the Hamburg Power Station, where a 15,000-b.hp. two-stroke double-acting engine is installed, also in one of the Berlin stations where there are two 11,000-b.hp. engines.

By far the biggest installation, however, is that for the Copenhagen Power Station. Two or three years ago, it was decided that considerable extension would be needed, and because Burmeister & Wain, pioneer diesel engine builders, have their works in Copenhagen, the question of building a new central station wholly with oil-engine drive was considered. It was, however, decided that, for the bulk of the power, steam turbines would be more economical, but that a large diesel generating unit should be provided mainly for raising the peak load.

An order was, therefore, placed for a 15,000-kw. alternator set, and it was specified that the diesel engine coupled to it should have a normal output of 21,000 b.hp., but that if necessary it should be able to develop 22,500 b.hp. continuously. It is this unit which has just been completed by Burmeister & Wain, and which, after trials, will be installed in the Copenhagen Power Station. It is, however, in a building separate from the main steam and boiler plant, space being available for additional sets if and when required. The manufacturers of the engine, based upon the experience they have now attained, claim that if all costs be taken into consideration, including that of the building in which it is housed, a large diesel-driven alternator can be constructed more cheaply than a corresponding turbine and boiler plant. Also based upon their experience, they now put forward plans for the construction of a diesel-driven alternator of 30,000 kw., with an engine of over 40,000 b.hp. in twelve cylinders, running at 187 r.p.m.

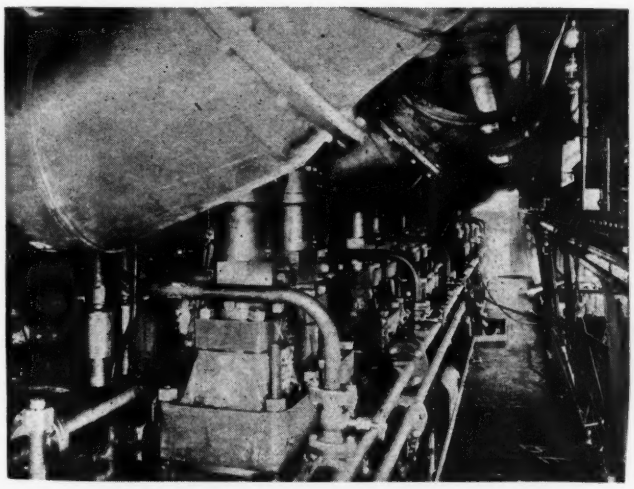
The new 22,500-b.hp. engine, which operates on the double-acting two-stroke-cycle principle, but which differs essentially in its construction from other diesel motors of this class, has a guaranteed fuel consumption of 0.55 lb. per kw.-hr. at the normal load of 15,000 kw. The maximum efficiency is at 12,500 kw., where the consumption is guaranteed not to exceed 0.53 lb. per kw.-hr. When the output of the alternator is 6,250 kw., the guarantee is 0.58 lb. of oil per kw.-hr.

In this engine, the scavenging ports are at the center, while exhaust gases are discharged through piston plug valves at the top and annular valves about the piston rod at the bottom of the cylinder. Mean effective pressures

permissible are claimed considerably higher than in other two-stroke double-acting engines. In this particular motor, the average m.e.p. referred to indicated power is 106 lb. per sq.in. As the mechanical efficiency is 82 per cent, the corresponding m.e.p. referred to brake power is about 87 lb. per sq.in.

Addition of exhaust slide valves naturally complicates the design. The upper and lower valves move together, being connected by beams at top and bottom and vertical rods at each side. Drive is from the crankshaft, which is coupled to an auxiliary shaft by means of a chain. This latter drives the exhaust valves through eccentric rods. The entire drive is enclosed within the crankchamber.

The engine is of the solid-injection type, fuel being injected under a pressure of about 5,000 to 6,000 lb. per sq.in. through atomizing valves, of which there are three at the top and three at the bottom. Fuel pumps are



Two vertical fuel pumps are provided for each cylinder, one supplying fuel to the upper valves, one to the lower

driven from a camshaft which runs horizontally along the front of the engine and is driven by chain from the crankshaft. Two fuel pumps, vertically disposed, are provided for each cylinder, one supplying oil to the upper fuel valves and the other to those at the bottom cylinder cover. Fuel pump plungers are actuated from cams located on the camshaft. For starting purposes, compressed air is supplied to valves which automatically open in the cylinder head, after which the main supply of compressed air enters the engine. No valve levers have to be provided for these starting valves, a suitable distributor being arranged close to the starting platform.

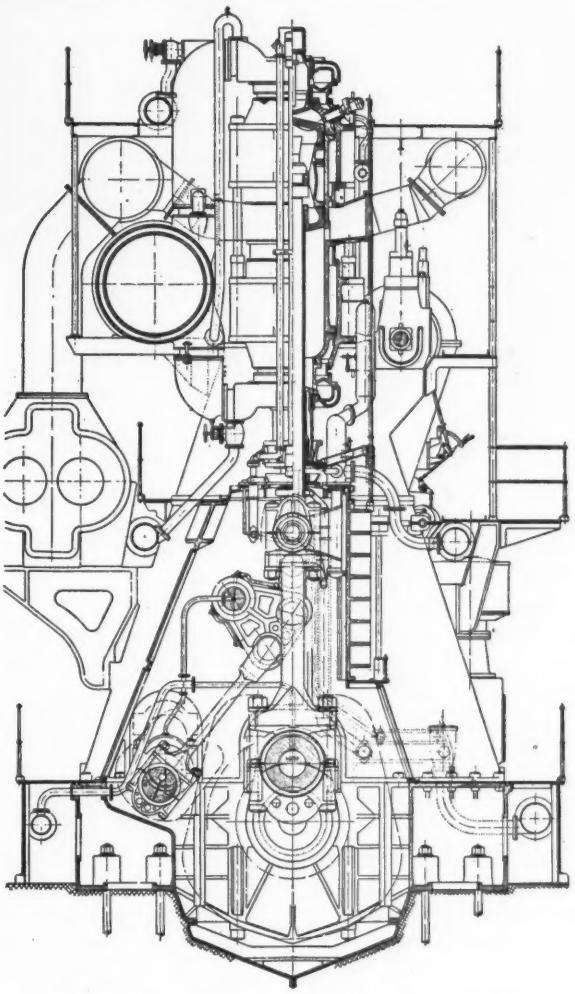
Air for scavenging purposes is furnished by two rotary blowers driven by spur gearing from the auxiliary shaft. They are duplicates, and air from them is delivered into a large scavenging trunk arranged horizontally along the engine. The scavenging air pressure is about 1½ lb. per sq.in., and the speed of rotation of the blowers is approximately double that of the engine shaft.

A feature of the plant and an element without which it could not have been satisfactorily constructed for this particular purpose is what is termed an oscillation damper. It consists of a flywheel housing capable of turning on a sleeve keyed to the crankshaft. Two spiral springs attached to the sleeve cause the flywheel housing to rotate, and in the sleeve are eight hydraulic cylinders supplied with lubricating oil through a distributor. This distributor closes the oil inlet a dozen times each revolution, so that the flywheel housing is disconnected every five seconds from the shaft. Dangerous oscillations at critical speeds of rotation are thereby avoided.

Steel is used more in the construction of this engine than is normal in diesels. Both the upper and the lower cylinder covers are of cast steel, while the center portion of the piston is also of steel. Cylinder liners, in two sections, are of iron.

The engine drives a cooling water pump which supplies all the cooling water for the cylinders and covers, but the pistons are cooled by lubricating oil, and an oil cooler is incorporated in the circuit. The over-all length of the engine is somewhat under 65 ft., while the height is in the neighborhood of 35 ft.

The eight cylinders have diameters of 840 mm. (33 in.) and piston stroke is 1,500 mm. (59 in.). Speed of revolution is 115 r.p.m. This cylinder diameter is probably the largest thus far used in diesel engine construction, and even in their proposals for engines of double the output, the builders do not suggest increasing cylinder bore. For the 40,000-b.hp. unit to which reference has been made, they would increase the number of cylinders to twelve, and raise the speed to 187 r.p.m.



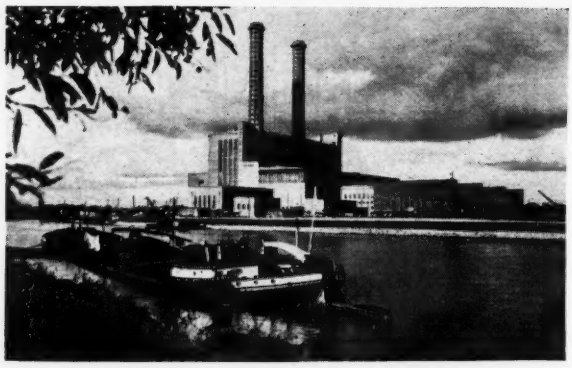
Sectional elevation of one cylinder of the engine

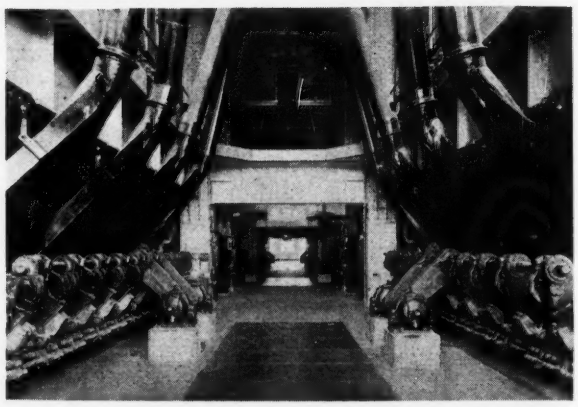
WEST STATION BERLIN

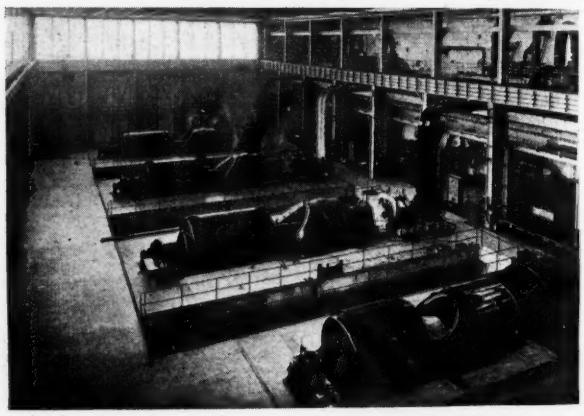
A MODERN EUROPEAN PLANT

By Dr. Ing. W. E. WELLMANN
Manager, BEWAG, Berlin

Because of the low load factor expected at this plant, low first cost was a design requirement. German brown coal is fired on under-feed stokers, using relatively high air preheat







West Station, Berlin, on the River Spree (top) has stokers of American manufacture (center). Three of the main units and one house alternator may be seen in this view of the turbine room (bottom)

IN 1928 it became apparent that the increasing demand for power in Berlin would require the installation of additional generating capacity to serve the system of the Berliner Städtische Elektrizitatswerke, A. G. In planning the station it was assumed that the character of the load curve, in Berlin, would not change, making necessary a plant which would operate with relatively constant loads during the day, but with extremely small loads at night. For this reason, consideration was given to various methods of sustaining peak loads. Furthermore, first cost was considered more important than low coal consumption. The studies led to the construction of a 200,000-kw. plant with a 50,000-kw. steam accumulator installation, and a large battery reserve.

A base-load station had been erected some years ago in the eastern section of the city. Because of this the new station was located in the west side of the city in order to secure better distribution of energy. A satisfactory location was found on the River Spree, convenient to existing railway facilities.

The station was planned for 355-lb. pressure and 797-deg. steam at the turbine throttle, the boilers being designed for 454 lb. per sq.in. These steam conditions were selected because the boiler with welded drums and riveted heads would be less expensive than a boiler of higher pressure, and the moisture content of the steam at the turbine exhaust would not exceed 10 per cent, making reheating unnecessary.

The German wage situation, the cost of material and the given load conditions led to the selection of turbines of 34,000-kw. capacity. The probable necessity of frequent starting and stopping of turbines also influenced the selection of this size unit. Six units of 34,000 kw. were installed, together with two house turbines of 12,000 kw. each. The main units operate at 3,000 r.p.m., are of the tandem-compound type, and are arranged for bleeding from one stage at 15.92 lb. pressure.

At Klingenberg, the stored coal had been blown about. To avoid this, the brown coal, received by barge and unloaded by bridge cranes, is stored in a concrete-walled yard of 33,000 tons capacity. From the storage yard coal is carried to the station bunkers, from which it is delivered to the stoker hoppers.

Eight cross-drum boilers of 25,824-sq.ft. heating surface each have been arranged in two rows of four boilers, with the firing aisle in the center. Air preheaters have been provided to heat the air for combustion to 392 deg., with the possibility of later increasing the temperature to 572 deg. Economizers have not been installed, the feed-water temperature being 302 degrees.

Brown coal is fired in Taylor underfeed stokers of 20 retorts and 49 tuyeres long. Stokers were chosen instead of pulverized coal because, the price difference between coal for stokers and that for pulverizing has been greatly reduced, the fly ash nuisance in case of pulverized coal calls for installation of expensive electrical precipitators, the stoker slag can be sold, while disposal of the fly ash leads to additional cost.

A feature of the station is its heavy structural steel building framework, designed to carry the total load of two brick stacks which extend 210 ft. above the boiler house roof. They have an inside diameter of 20 ft. 8 in. and to reduce weight are constructed in skeleton form of reinforced concrete with the panels between the girts and columns filled with a light-weight porous insulating concrete faced with hollow interlocking tile. The entire chimney is lined with interlocking fire tile.

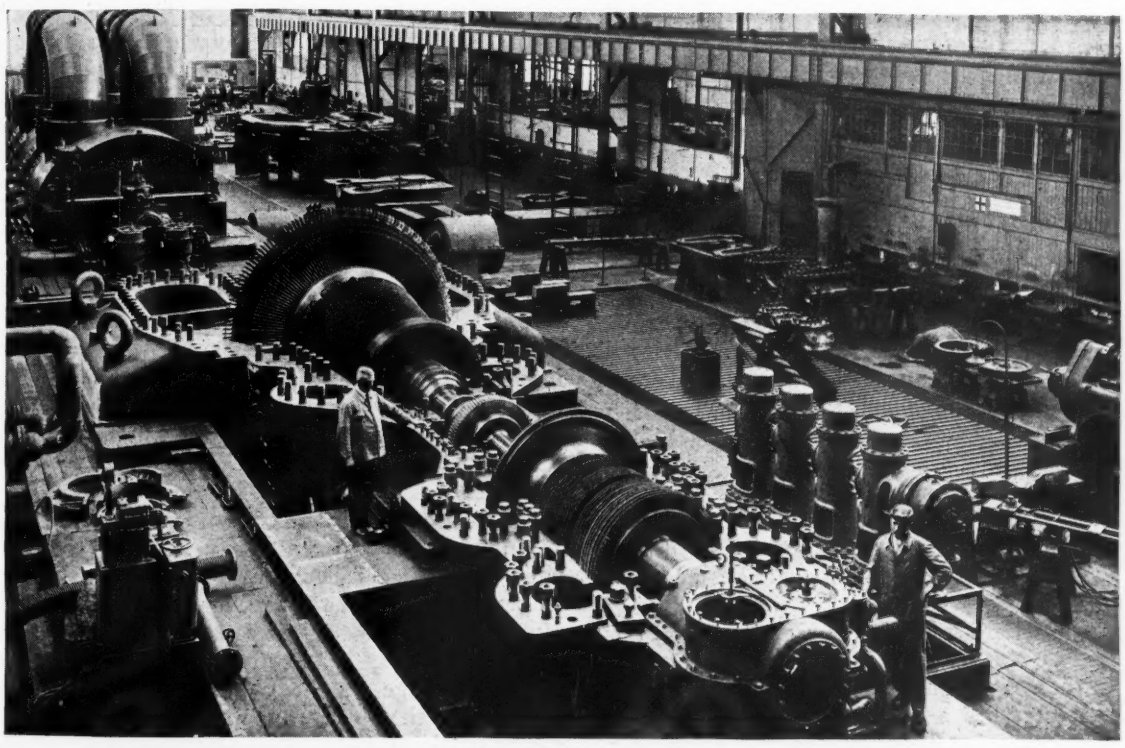
Condenser circulating water pumps are installed in a separate building outside the power station to avoid deep inlet canals, and to secure more economical combination of unregulated pumps in case of changing loads and water temperatures. The circulating pumps are of the vertical propeller type.

The station heat balance arrangement is relatively simple. Condensate from the main unit passes first through a bleeder heater supplied with low-pressure steam bled from the high-pressure cylinder of the main units. It then passes through an evaporator condenser, and then to a feed-water heater supplied with steam at 84-lb. pressure bled from the house turbines. Steam for the evaporators is also taken from the steam bled from the house turbine. The entire condensate system is closed, the hot water storage and surge tank being maintained under 70-lb. pressure.

All auxiliaries, except forced and induced draft fans, are driven by squirrel cage motors. These motors have no undervoltage release, and, therefore, if the normal service fails, the complete auxiliary service can be started up again by direct inter-connection with another feeding source. Tests show that no severe voltage fall follows this procedure. Only the motors of the boiler feed pumps are equipped with a time lag under voltage release, thus allowing separate starting to observe the operation of the pump. Two of the six feed pumps and one fire pump are driven by steam turbines.

Before starting erection of the station an accurate cost schedule was set up and classified to correspond with the main parts of the station. This schedule was used as a budget. By comparing all orders with it during the erection of the plant, it was possible at any time to judge the difference between the probable plant cost and budgeted cost. In this way increases or decreases over budgeted costs were discovered, and compensated for by changes in construction or other savings. The station costs were figured at $55.25 per kilowatt for the power station, and $7.15 per kilowatt for the substation, and were distributed among the various sections of the station in the following manner:

	Per cent
Boiler house	26.5
Turbine house	20.7
Piping and insulation	4.5
Feed water and cooling water handling	3.4
Electrical auxiliary service	8
Substation and switching equipment	13
Store, workshop and office building, cranes, hoists, railroads and harbor, supervisory control and miscellaneous charges	17.9



Political upheaval has not halted technical progress in Germany. This partly assembled two-cylinder turbine on the erection floor of the Mülheim-Ruhr Works of Siemens-Schuckertwerke has a maximum capacity of 52,000 kw. It is designed to operate at 1,500 r.p.m. with throttle steam at 355 lb. pressure, 725 deg. F. and exhausting at 0.48 lb. abs. back pressure. The unit in the left background is the world's largest 3,000 r.p.m. turbine, capacity 60,000 kw. It is to operate with steam at 497 lb. pressure and 797 to 878 deg. F.

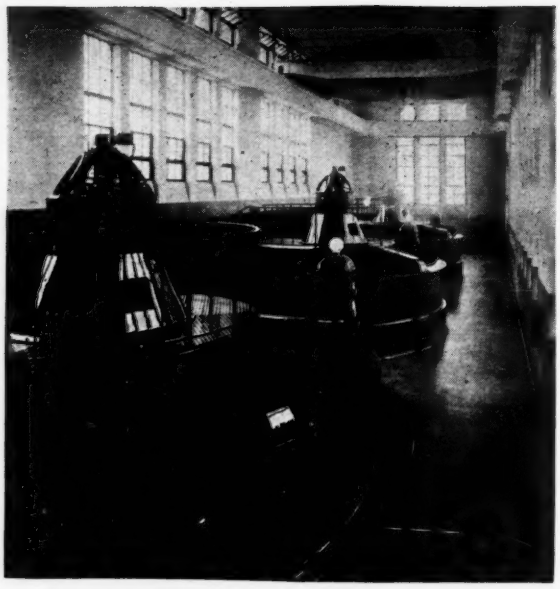


Fig. 1—Three 4,000-kva. units are installed in Eagle Pass plant

Refinement of plant design wins a maximum turbine efficiency of 93.9 per cent and an over-all unit efficiency of 90.7 per cent in the hydro-electric plant of the Central Power and Light Company, Eagle Pass, Texas.

4,500-HP. HYDRO TURBINE GIVES 93.9% EFFICIENCY

By L. F. HARZA and ERIK FLOOR

President *Vice-President*
Harza Engineering Company, Chicago, Ill.

PHENOMENAL improvements in hydro-electric station efficiencies cannot be expected because efficiencies are already so near the limit of perfection. Improvements of one or two per cent, however, mean much to the income of an operating company. It is our belief that the newly complete hydro-electric station of the Central Power and Light Company at Eagle Pass, Texas, has set a new mark to shoot at in hydro-station efficiencies—at least for stations and units of comparable size.

This station comprises three units at the end of an irrigation diversion from the Rio Grande River, returning water to the river about ten miles above Eagle Pass, Texas. Each unit has a normal rating of 4,000 kva. at 0.80 power factor for the generator, and 4,500 hp. at 225 r.p.m. under 81-ft. head, for the turbine.

The turbines are of the vertical francis type, having a specific speed of 64, and are set in lap-riveted steel-plate scroll cases over elbow draft tubes built in concrete. They are supplied by S-shaped lap-riveted steel-plate penstocks 11 ft. in diameter, from a concrete intake structure at the top of the hill. The penstocks have three bends—two of major angle and one slight bend, Fig. 4.

The plant was tested in April of this year by the Gibson method, E. B. Strowger in charge. In the table are given the efficiencies obtained by the test, both for the turbines and for the units as a whole from water level in forebay to switchboard, at points of best efficiency and at half load. Conditions were ideal for obtaining accuracy by the Gibson test. As indicated in Fig. 4, there was a straight length of penstock between the differential taps, for obtaining the pressure-time diagrams, of about 120 feet.

Unit No. 3 has a slightly better efficiency than No. 1 and considerably higher than unit No. 2. A satisfactory explanation of this is not available, except that efficiencies are sensitive to slight influences, especially in the case of units having small total losses as in this case. Setting of the runners, particularly as it affects disk friction on the upper crown, bearing friction, variations in roughness of the runners' passages, and differences in their running clearances have an important effect upon turbine efficiencies.

It is reasonable to expect a greater difference between individual unit efficiencies of small than of larger units, on account of the relative influence of variations in some of the losses. Disturbance in the water approaching the units may be slightly different. Because of unequal shrinkage of the castings there are small differences in the three runners. The variations in efficiency of these three turbines are not out of line with those frequently obtained in other tests where units were supposed to be identical. In general, the losses in a hydraulic turbine are not susceptible to the same degree of predetermination in design and realization in the

field by test as are electrical losses of the generator.

Fig. 3 shows the guaranteed efficiency of the hydraulic turbines; Holyoke test No. 3166 upon which the design of the larger units was predicated; and the three turbine efficiency curves determined by Gibson test. The high efficiencies obtained are not accounted for by any one fact, nor can they be credited to any one individual or organization. They are largely the result of close attention to detail in design of all parts of the equipment, and of the station itself.

The turbine efficiencies are more remarkable because the manufacturer had no developed type of the specific speed specified. Therefore, Holyoke tests of successive model runners were specified until a runner should have been obtained whose characteristics satisfied the consulting engineers. The second model runner built by the turbine manufacturers and tested at Holyoke was satisfactory, closely paralleling the guaranteed curve, Fig. 3. It gave an efficiency of 94.57 per cent by test at Holyoke, the highest ever obtained there. A small model of this runner was also tested in the manufacturer's testing flume to verify the efficiency of the elbow draft tube as compared with a straight-conical-tube model of the one used at Holyoke.

Eternal vigilance was applied in the design of the station to eliminate losses wherever practicable without exorbitant expense. It is significant that frequently the elimination of losses is not a matter of increased expense of manufacture or construction, but one of more attention to detail in design, accompanied necessarily by some increased engineering expense.

The intake structure curves were shaped to accelerate the water from forebay into the penstock with as little disturbance as possible and to obtain uniform distribution of velocity over the section of both intake structure and penstock.

Probably the most important feature of design contributing to small penstock losses, and also perhaps an important factor in the turbine efficiency, was the use of a reducing elbow ahead of the turbine. It has been the practice of the designing engineers of this project, for some years, to make all contractions in sections where practicable at elbows. This has been in the belief that disturbances are largely eliminated if the cross-section of flow contracts simultaneously with a change in direction, thus forcing the water to follow the elbow properly, even on the inside of the bend.

The engineers have not previously, however, had an opportunity to verify the value of this refinement. That it is of value was demonstrated in the test of this station. Four piezometers about the circumference of the penstock, to determine the net head on the turbine for efficiency calculations, were located just below the elbow, as indicated in Fig. 4. Piezometers in such a location would show considerable agitation if the elbow were of constant section, and probably all four would not indicate identical pressure. In this case, however, there was an entire absence of disturbance in the piezometers at all loads. Identical readings were obtained from the individual piezometers in all four quadrants of the penstock cross-section.

Considerable data have been accumulated in the last few years to indicate that a disturbance from any source ahead of a turbine will considerably affect its efficiency by going through the runner. It is good practice to use as long a horizontal tangent as possible in the penstock ahead of the scroll case to smooth out the disturbances caused by a uniform section elbow in an S-shaped penstock installation, as in this case.

In the design of some recent stations the engineers have placed the intake in deep water so as to bring the water from the reservoir to the turbine in a horizontal penstock without bends. This practice greatly increases the cost of the gates, trash racks and other intake parts. Such a design was impossible at Eagle Pass because the canal at the top of the hill did not provide depth for a low-level intake. It is believed that the high efficiency obtained in this installation, lack of disturbance, and identical indication of the four piezometers just below the lower elbow indicate that an S-shaped penstock can be used without detriment to turbine efficiency if the lower elbow ahead of the turbine contracts in section.

Other features undoubtedly contributing to efficient results were conservative penstock velocities, conservative specific speed of the turbine, and close attention to

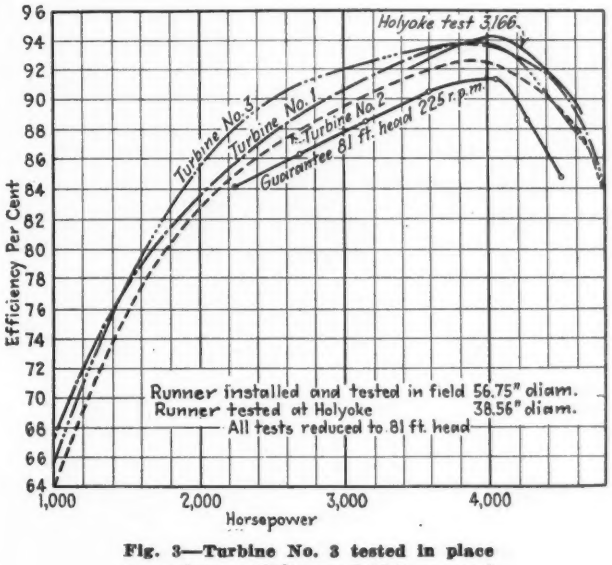


Fig. 3—Turbine No. 3 tested in place a maximum efficiency of 93.9 per cent

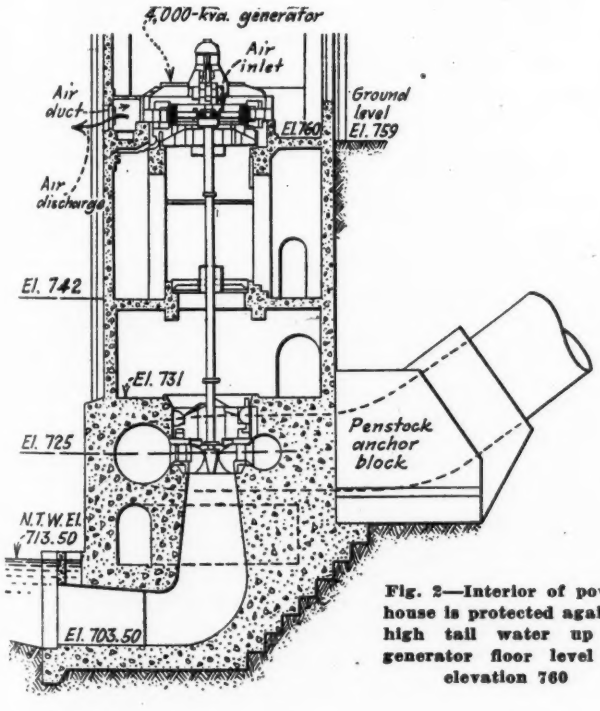


Fig. 2—Interior of power house is protected against high tail water up to generator floor level at elevation 760

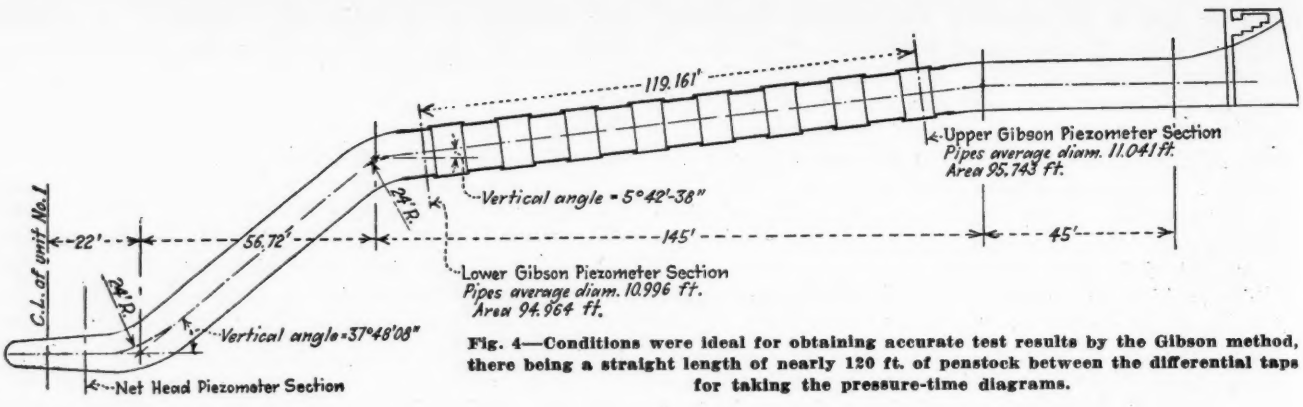


Fig. 4—Conditions were ideal for obtaining accurate test results by the Gibson method, there being a straight length of nearly 120 ft. of penstock between the differential taps for taking the pressure-time diagrams.

Efficiencies Obtained at Eagle-Pass Hydro Station

Unit No.	Turbine Efficiencies Best Point	Turbine Efficiencies Half Load	Over-all Efficiency of Units Best Point	Over-all Efficiency of Units Half Load
.....	93.8	86.6	90.5	82.8
2.....	92.7	85.8	89.7	82.4
3.....	93.9	89.0	90.7	85.0

minor details. The efficiencies indicated are for 100 per cent power factor of the generators, which was maintained at this value for purposes of test.

The generator design is noteworthy in respect to its ventilation system. Ventilating air is taken in at the top of the generator near the shaft from underneath the circular walkway. After passing through the coils, the cooling air is collected in an eccentrically positioned horseshoe-shaped steel drum around the generator. This discharges laterally through louvres in the powerhouse wall directly to the atmosphere. Another feature is the use of welded generator frames without unnecessarily sacrificing the appearance of the machine. The appearance of many welded machines built thus far in this country is not such as to encourage their use, and has not always been a credit to the manufacturers, nor in keeping in appearance with the remainder of the station and equipment.

Generator Efficiencies

The efficiencies of the generators at 100 per cent power factor were: At 4,000-kw. load, 97.2; 3,000-kw., 96.9 per cent; 2,000-kw., 96.1 per cent; and 1,000-kw., 93.2 per cent.

In no small measure the efficiency of this station can also be credited to the close cooperation between manufacturers and consulting engineers during the development, design and building of the equipment. Such cooperation can only result in benefit to the project as a whole, and, therefore, to the client. The engineer, as a coordinating center between the several manufacturers, designers and the general contractor, is in a position to bring about a harmonious correlation of details of all parts of the station, and consequent improved performance.

The equipment manufacturers are to be congratulated for their excellent results, especially the turbine manufacturers, whose equipment largely determines the efficiency of the units.

The hydro-electric project is the property of the Central Power and Light Company, San Antonio, Texas, a subsidiary of the Central & Southwest Utilities Company of Dallas, which is a subsidiary of the Middle West Utilities Company of Chicago. J. T. Persons had general supervision for the Central Power and Light Company; G. A. Mills for the Central & Southwest Utilities Company; and G. W. Hamilton for the Middle West Utilities Company. With the exception of the substation, which was engineered by the Central Power and Light Company, the Harza Engineering Company of Chicago engineered the project, Erik Floor and Jas. S. Bowman being in immediate charge of design, and C. E. Wattles, resident engineer on construction. Bart Moore of San Antonio was general-construction contractor; turbines by James Leffel and Company; generator and switchboard by Westinghouse Electric and Manufacturing Company; governors by Woodward Governor Company.

NEW METHODS SAVE $500,000

In 1931 the National Biscuit Company cut power service costs $250,000 in its 85 plants. At the present rate the 1932 saving will be over $500,000. The story was told in the August number of *Power*, Behind this saving is a business philosophy of 1932, told as follows in the words of R. R. Galloway and John M. Acheson of National Biscuit.

▼

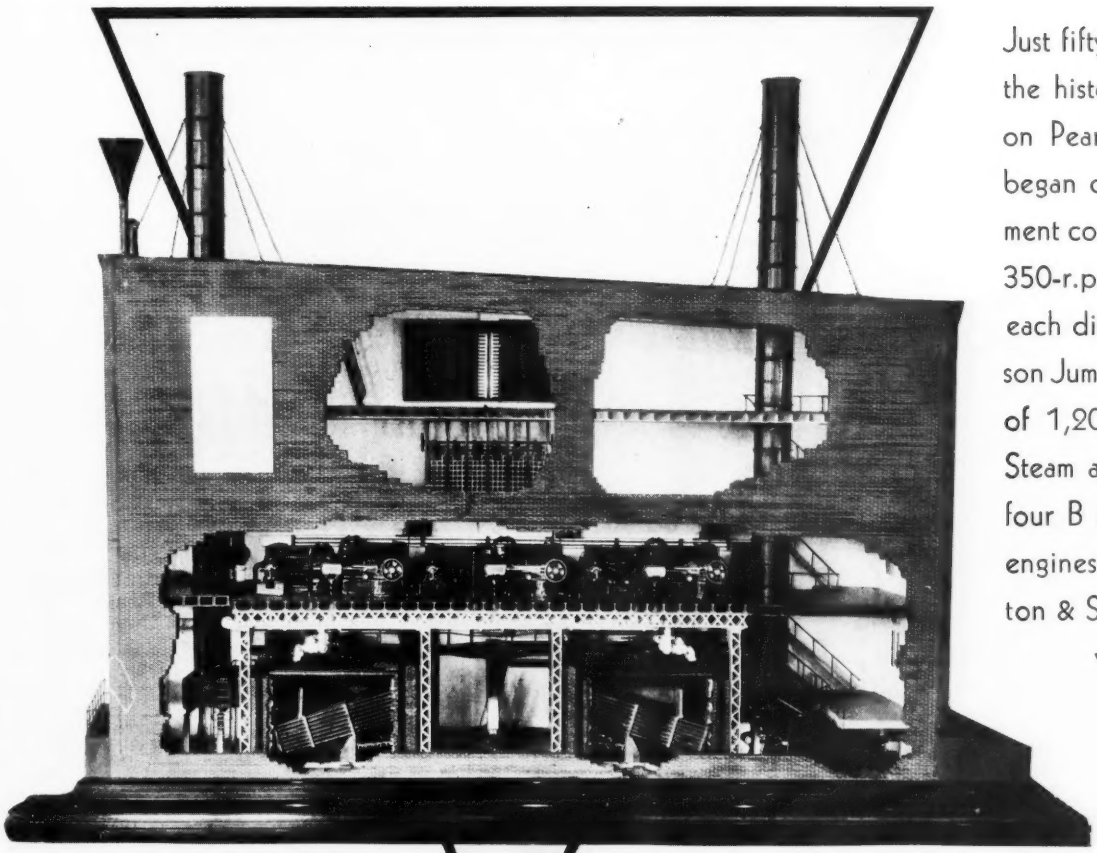
"THE depression that started in 1928, which despite optimistic utterances to the contrary is still running its course, has taught us many things. Strict competition and falling markets have had their effects on all business, and to such an extent that they have driven many establishments to close their doors. Even our strongest industries are finding it extremely difficult to cope with present conditions.

"As we look around us today, we find one type of executive who, through these trying years, has become panic stricken. In his frenzied rush to keep abreast of the times, he goes along blindly slashing here and there without any thought of what his actions of today will mean to his business tomorrow. He is overlooking essential aids to business recovery by failing to recognize and eliminate inferior methods of manufacturing.

"Another type of executive has used the past few years to study every phase of manufacturing within his own plants, to eliminate all uneconomical methods *now*, so that full advantage can be taken of the upturn in business, which we all hope is not very far off.

"It requires courage on the part of the sponsoring executive in any concern to expend time and money to have his methods analyzed in times like these, but great will be the reward of those who possess that courage and have the patience to await the results."

PIONEER CENTRAL STATION



Just fifty years ago, Sept. 2, 1882, the historic Edison Central Station on Pearl Street, New York City, began operation. Original equipment consisted of 125-hp. (normal), 350-r.p.m., Porter-Allen engines, each directly connected to an Edison Jumbo dynamo having a capacity of 1,200 16-cp., 110-volt lamps. Steam at 120 lb. was supplied by four B & W boilers. The original engines were replaced by Armington & Sims engines shown in these views of the model.

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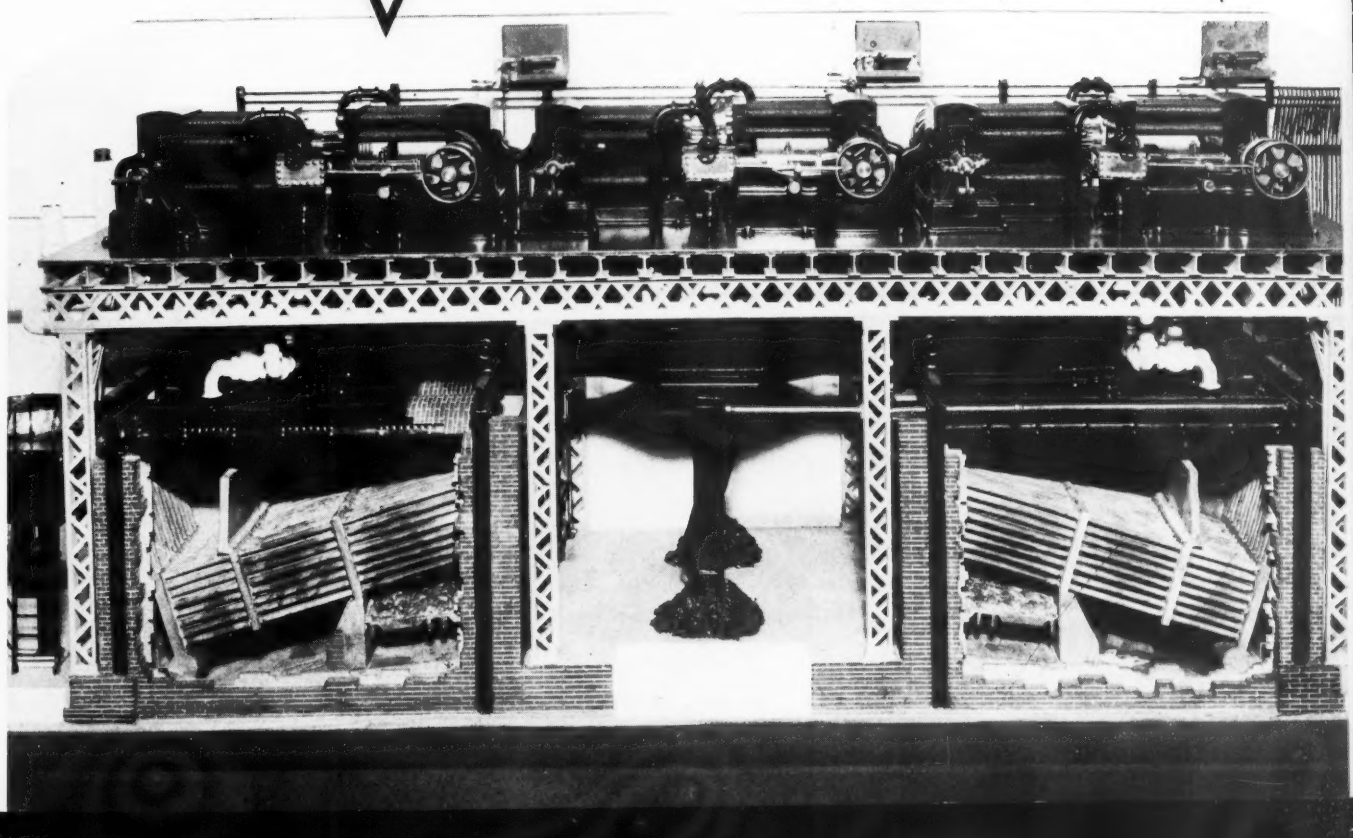


TIDE WATER RE-*refines*

PROVES TYCOL HAS

Tide Water's Special Edeleanu Process lowers Oxidation Number of competitive oils from 43 to 5...removes 16% (average) sludge-forming impurities from leading turbine and Diesel oils

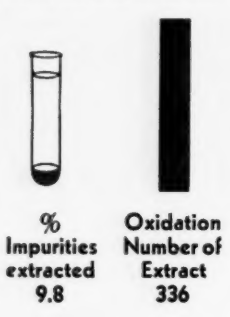
Stability . . . that's what you want in an oil! Whether you get it or not, depends largely on how your oil was refined.

To prove this, Tide Water bought in the open market 12 competitive brands of turbine and Diesel lubricating oils . . . and *re-refined* them by the Tide Water Edeleanu Process.

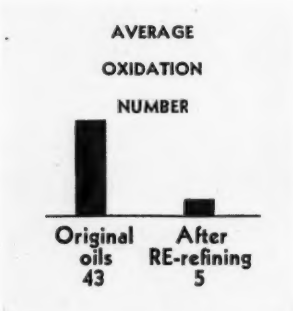
What a story the results told! The original average oxidation number of the oils was 43. Re-refining brought it down to 5! The average amount of extract from these oils was 16%! And it ranged in oxidation number from 144 to 399.

With such large percentages of high-oxidation-number extract to form sludge, acidity and carbon . . . no wonder improperly-refined oils break down!

TIDE WATER'S PROCESS REFINES OILS BETTER . . . **Unquestionably, the re-refining increased the stability of these oils . . . clear proof that Tide Water's Process results in better oils.**



Here are the reasons: The Process is a physical solvent treatment. It dissolves ALL unstable hydrocarbons, found even in the best of crudes. It starts NO chemical reaction upon the components of oil, stable or unstable. It forms NO new unstable substances. And it preserves the pure and stable hydrocarbons of highest lubricating value.



That is why Tycol Turbine and Diesel Oils, being 100% paraffine base, and refined by this Process, have purity and stability which no other oils possess. Tycol Oils have oxidation numbers ranging from 1/4 to 1/50 of those of competitive grades.

GO BY TYCOL'S SERVICE RECORDS . . . **In the final analysis, it is service that counts. Everything shown in these laboratory tests is borne out by experience. Tycol oils have set up new records of performance for some of the country's leading producers of power.**

Based on these records, you can depend on Tycol oils for low acidity, low carbon deposition and better demulsibility. You can depend on them for stability, for non-sludging, long-lasting, efficient, economical lubrication!

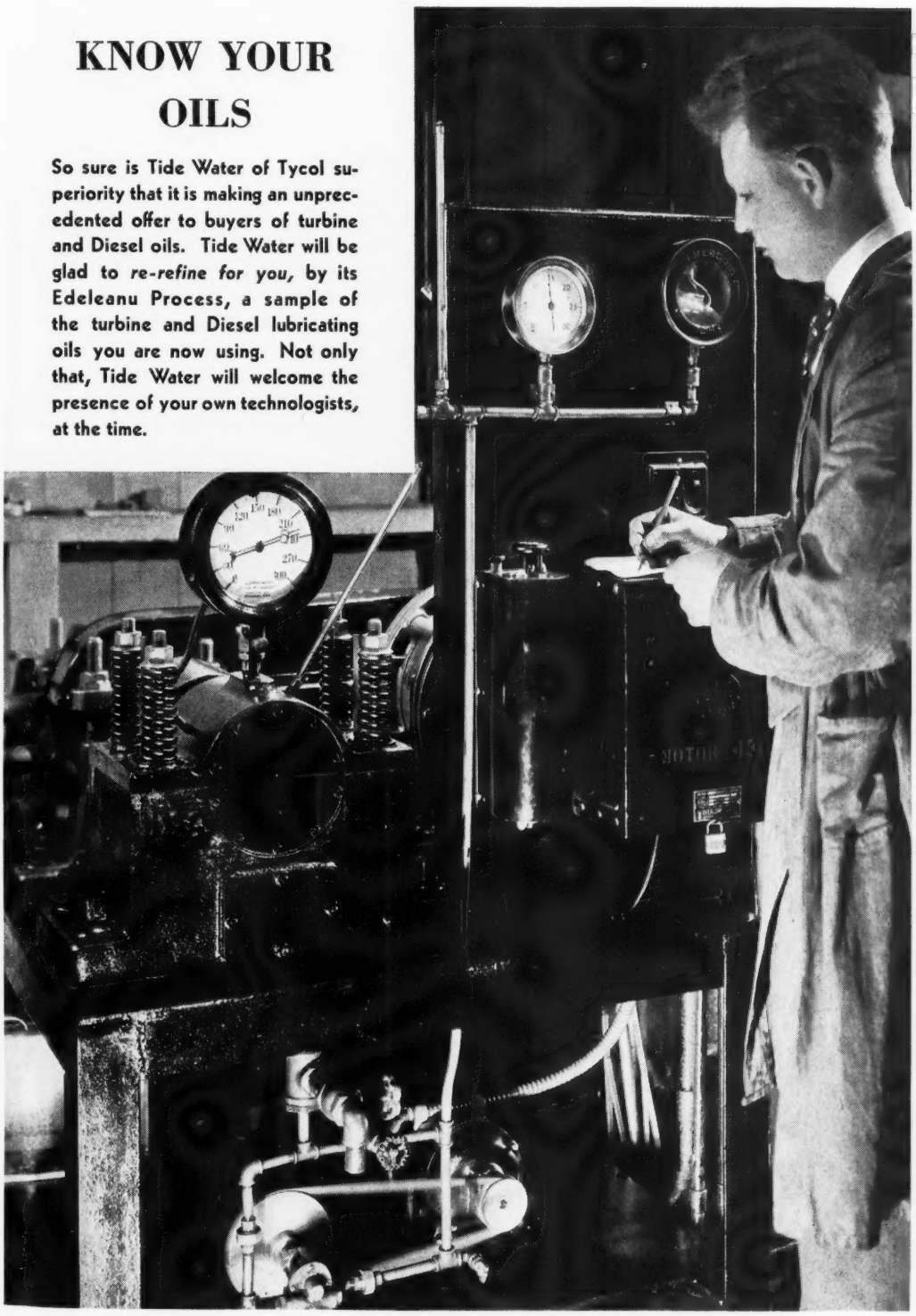
Tide Water has prepared a complete detailed Laboratory Report, "Re-refining 12 Brands of Oils." A copy of this booklet will be mailed upon request. Tide Water Oil Sales Corporation, 17 Battery Place, New York.

12 *Competitive Oils*

GREATER STABILITY

KNOW YOUR OILS

So sure is Tide Water of Tycol superiority that it is making an unprecedented offer to buyers of turbine and Diesel oils. Tide Water will be glad to *re-refine for you,* by its Edeleanu Process, a sample of the turbine and Diesel lubricating oils you are now using. Not only that, Tide Water will welcome the presence of your own technologists, at the time.



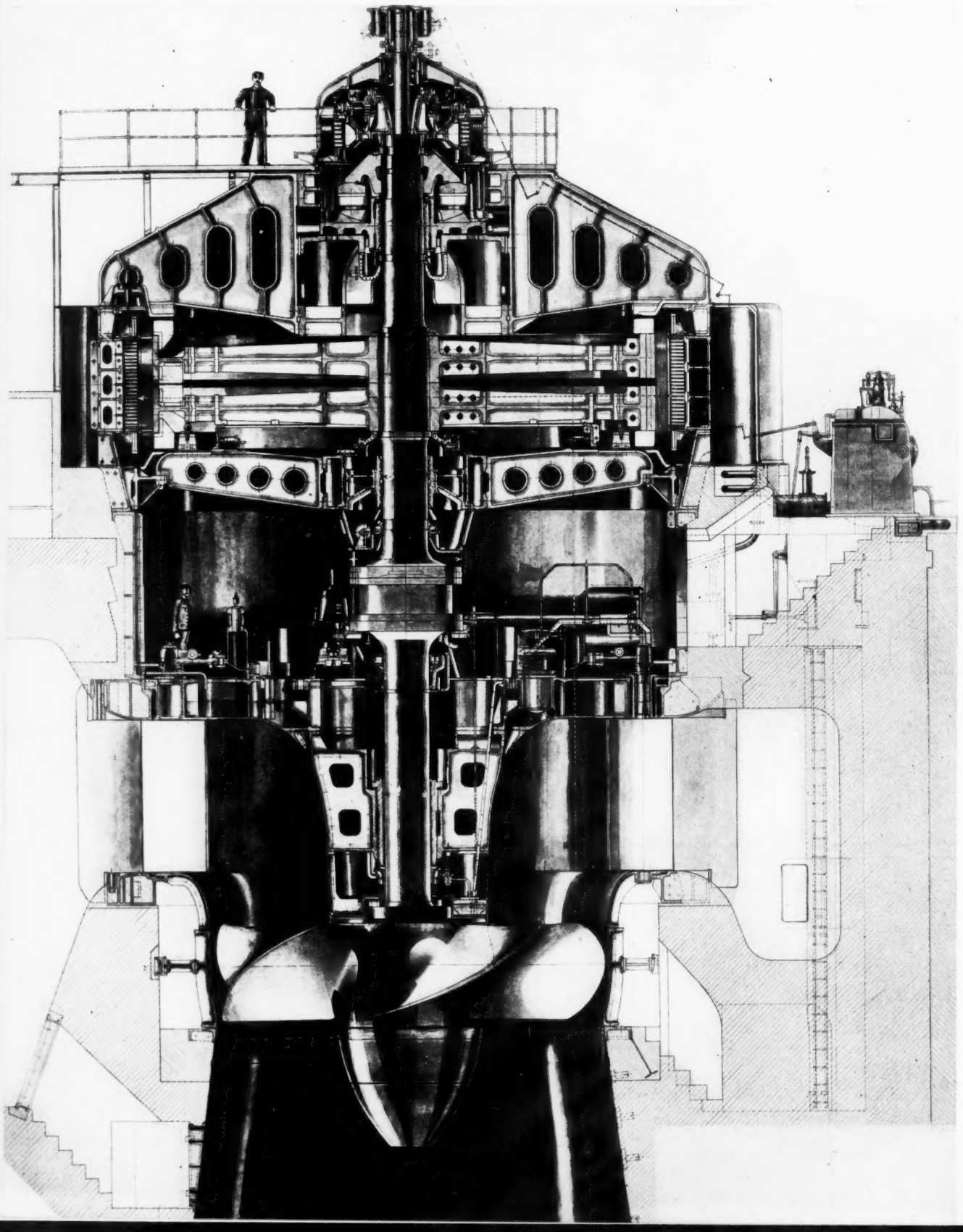
■ *U.S. Navy "Work Factor" Machine used by Tide Water to make one of many tests on Tycol Diesel and Turbine Oils. This machine gives these oils a "work factor" rating of 97% out of a possible perfect score of 100%.*

INDUSTRIAL TYCOL OILS-GREASES

TIDE WATER

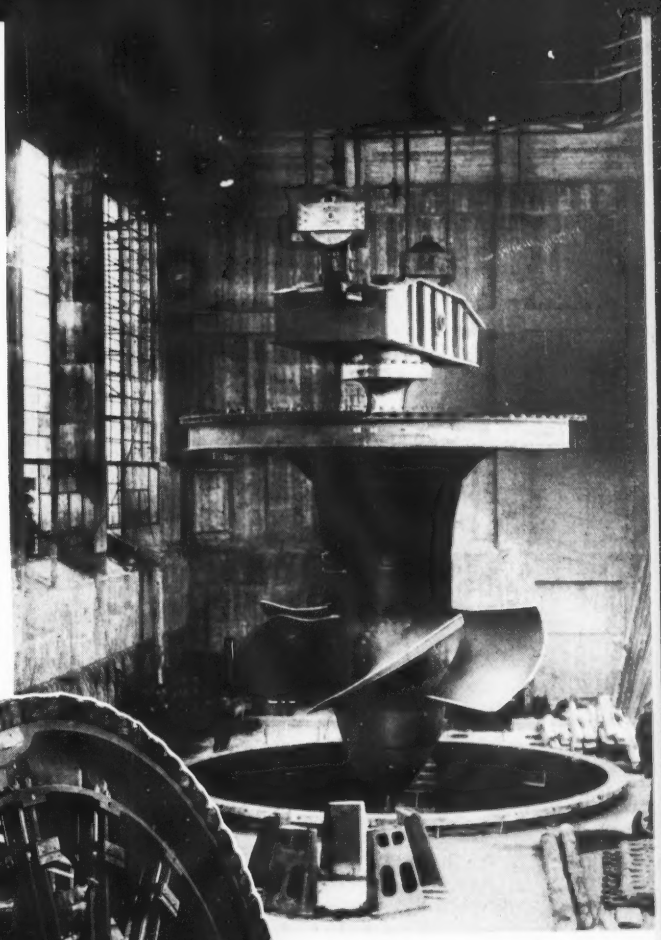
LARGEST KAPLAN TURBINES

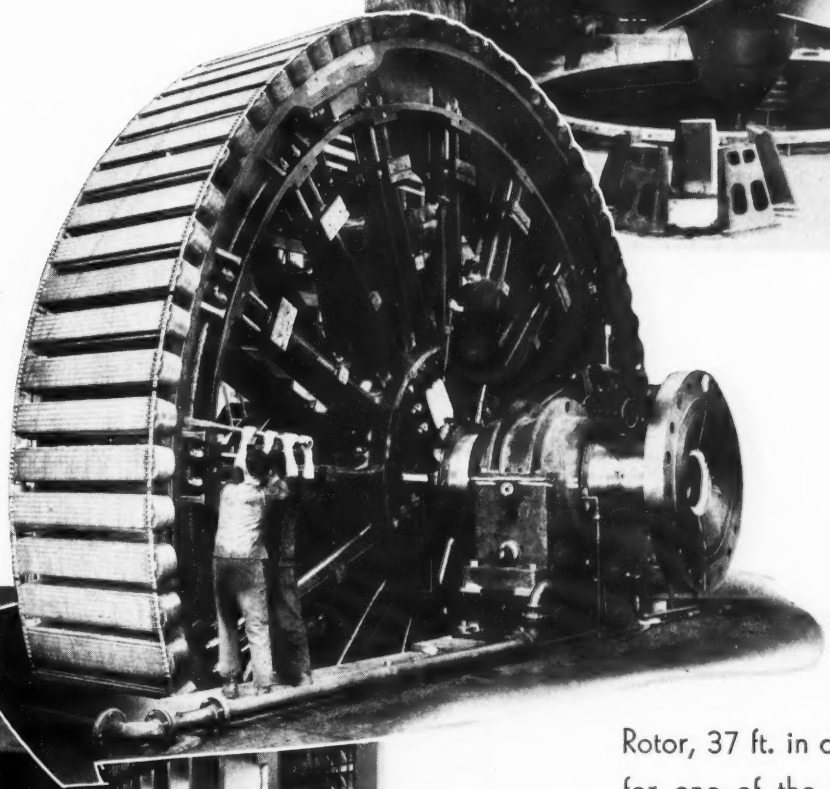
Between Germany and Switzerland, on the Rhine, is the Ryburg-Schworstadt hydro-electric plant. Here is a section through one of its 38,700-hp. units for 38-ft. head.



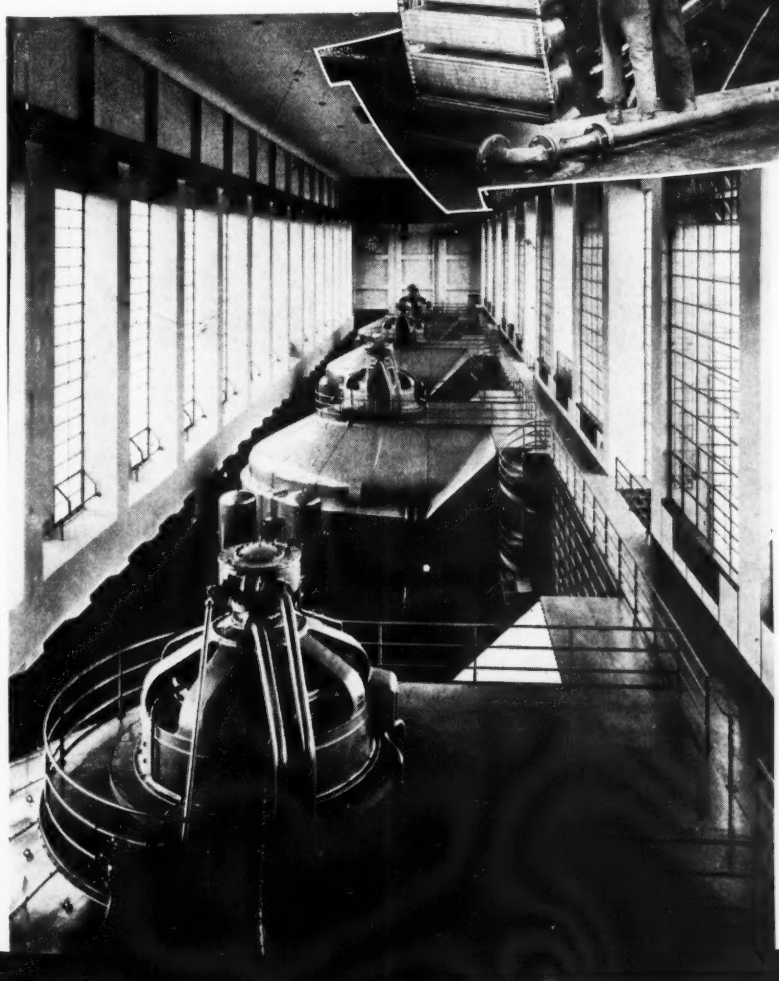
IN EUROPE

One of the Kaplan-type runners, with its cover plate, is lowered into place by two cranes. The runner is 23 ft. in diameter, and with its cover plate weighs about 250 tons.





Rotor, 37 ft. in diameter, for one of the 32,500-kva. generators being assembled in the shop. Its 80 poles are keyed to two cast-steel wheels.

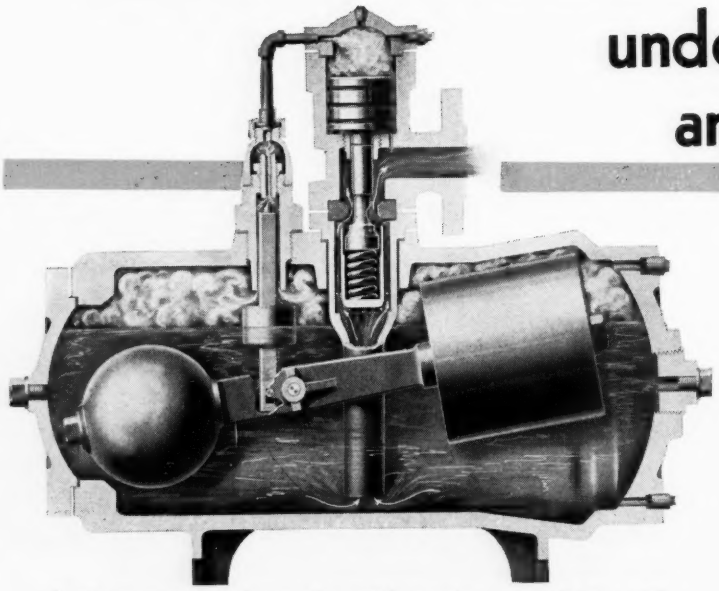


The plant contains four units. A maximum over-all turbine and generator efficiency of 89.4 per cent and a maximum turbine efficiency of 92.7 per cent were obtained in tests at about 28,000-hp. load.

Photographs courtesy Escher Wyss Engineering Works, Ltd., and Motor Columbus

Condensate Drainage

under all pressures and at all rates



A pilot operated, high capacity, quick opening, automatic trap with no floats to leak or collapse under pressure.

THE COCHRANE DISCHARGER

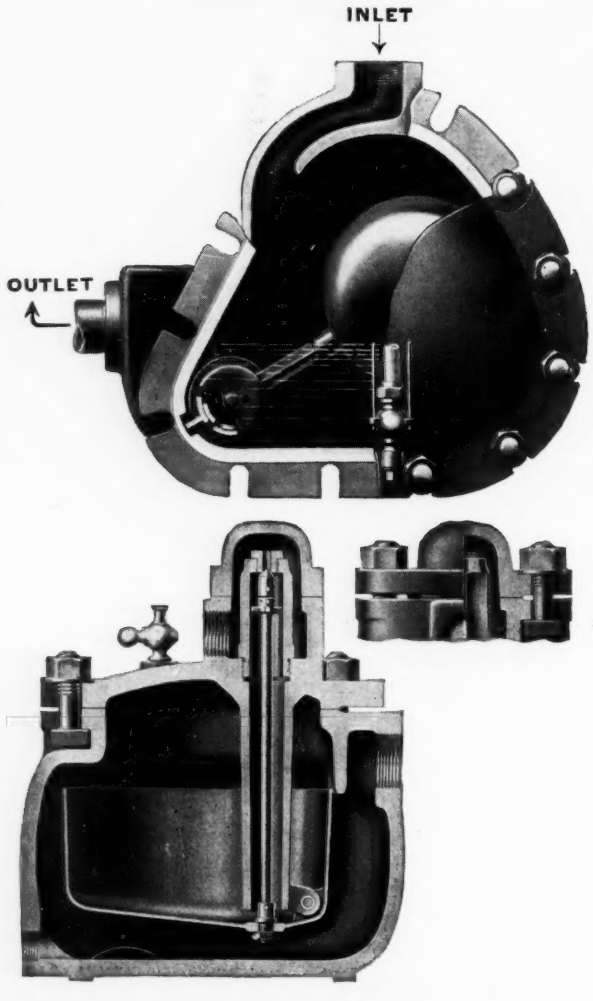
was developed to make possible the fulfillment of the exacting performance guarantees on the Cochrane Steam Purifier, which demands dependable high capacity drainage for pressures varying from 150 to 1850 lbs. per sq. in. Priming boilers send over very large quantities of water, but the Cochrane Steam Purifiers safely effect removal and the Cochrane Dischargers insure instant drainage; and this without the use of floats.

Cochrane Dischargers have been in continuous service draining Cochrane Steam Purifiers for over five years.

Cochrane Dischargers are equally efficient and effective for draining any type of steam purifier, large steam separators, large steam mains, heating coils, laundry machines, etc., in fact wherever high capacity drainage from pressure lines is required.

Forged steel, cast steel, or Nicromiron, according to the pressure, are used for the bodies.

Described in Cochrane Bulletin L-694



THE COCHRANE MULTIPORT DRAINER

is able to discharge enormous quantities of condensate under pressure differentials up to 75 pounds, as from heating coils or processes, due to its perfectly balanced valve and large port area. The valve, with the float and lever, forms a single part, at once removable when the cover is unbolted. An operating handle provides for opening or closing the valve manually. Used by U. S. Navy and in Mercantile Marine Service.

Described in Cochrane Bulletin L-685

THE COCHRANE BUCKET TRAP

is a simple, reliable drainer for moderate quantities of water under pressures up to 250 pounds in cast or alloy iron construction and up to 400 pounds in cast steel construction.

Described in Cochrane Bulletin L-685

COCHRANE CORPORATION, 17th & Clearfield Streets, PHILADELPHIA, PA.

COCHRANE
BOILER BLOW-OFF
VALVES

for the highest pressures and temperatures

REDUCE COSTS

They stay tight and do not waste B.T.U.'s by leakage. The cost of maintenance is practically nil.

22 COCHRANE FORGED STEEL TANDEM VALVES, Type C,

were installed by a large chemical plant for 600-pound pressure boilers in 1928 and these valves, as also eight additional ordered in 1930, are all working satisfactorily and have required *no repair parts*.

A large steel company which installed fourteen Cochrane forged steel valves for 600-pound pressure boilers has since purchased four additional valves, all reported to be giving drop-tight service.

Six Cochrane forged steel valves serving 1850-pound pressure boilers are entirely free from leakage.

Ten Cochrane Valves installed three years ago on 400-pound pressure boilers which require to be blown off every two hours have never required regrinding, replacement of parts or other maintenance.

Cochrane boiler blow-off valves are designed to *stay tight* under hard service over long periods of time. Tightness is insured by metal-to-metal seating on clean, hard surfaces of nitralloy.

The main valve disk is protected from flow and wire drawing, an auxiliary check taking the harsh, abrasive action of the blow-off discharge during opening and closing, while the rotary valve is relieved from its seat before being turned.

The Cochrane Tandem Blow-Off Valves, Type D (angle screw-down) and E (rotary plug) embody the same principles as the Type C all steel tandem valve, but are of less costly materials, *Nicromiron* being used for pressures up to 250 pounds and *cast steel* for pressures up to 400 pounds.

While either the D or the E unit may be used independently to supplement an existing valve, the combination gives the advantages of an easily operated, quick opening plug valve and an improved screw-down valve, which, together, insure drop-tight service over long periods.

Ask for Bulletin L-691 (high pressure), or
Bulletin L-693 (low and medium pressures)

V-6

COCHRANE CORPORATION, 17th & Clearfield Streets, PHILADELPHIA, PA.

POWER'S DATA SHEETS

NUMBER 3

CHART AND FORMULAS FOR FLOW OF OIL IN PIPES

THE total head under which any piping system operates is the sum of static and friction heads. When designing a system of piping the former is generally obtained from physical layout of the piping and data obtained from manufacturers of the equipment connected to the system.

The latter head, however, depends upon length of pipe, equivalent length of valves and fittings and velocity of the flowing liquid. Friction head may be calculated from the equation:

$$h_f = \frac{C \times l \times V^2}{D \times 2g}$$

Where h_f = friction head in feet, C = coefficient of friction, l = total length of pipe (actual plus equivalent length of valves and fittings), D = inside diameter of pipe in feet, V = velocity of flow in feet per second, and g = acceleration of gravity = 32.2. Of these quantities, all are known or may be assumed except the friction coefficient.

When oil is the fluid flowing in the piping system, viscosity becomes an important factor influencing the friction coefficient, and is a function of $\frac{d \times V}{V_k}$, where d = diameter of pipe in inches, V = velocity in feet per second and V_k = kinematic viscosity.

Viscosity of oil is usually expressed as the number of seconds required for a given volume of oil to flow through a viscosimeter. In the United States the Saybolt Universal Viscosimeter has been generally adopted and viscosities are given in "seconds Saybolt." In the chart below both kinematic and Saybolt (Universal) viscosities are given on the viscosity scale. It is important that the viscosity used be that of the oil at the temperature existing as it flows in the piping system, rather than that at some standard temperature.

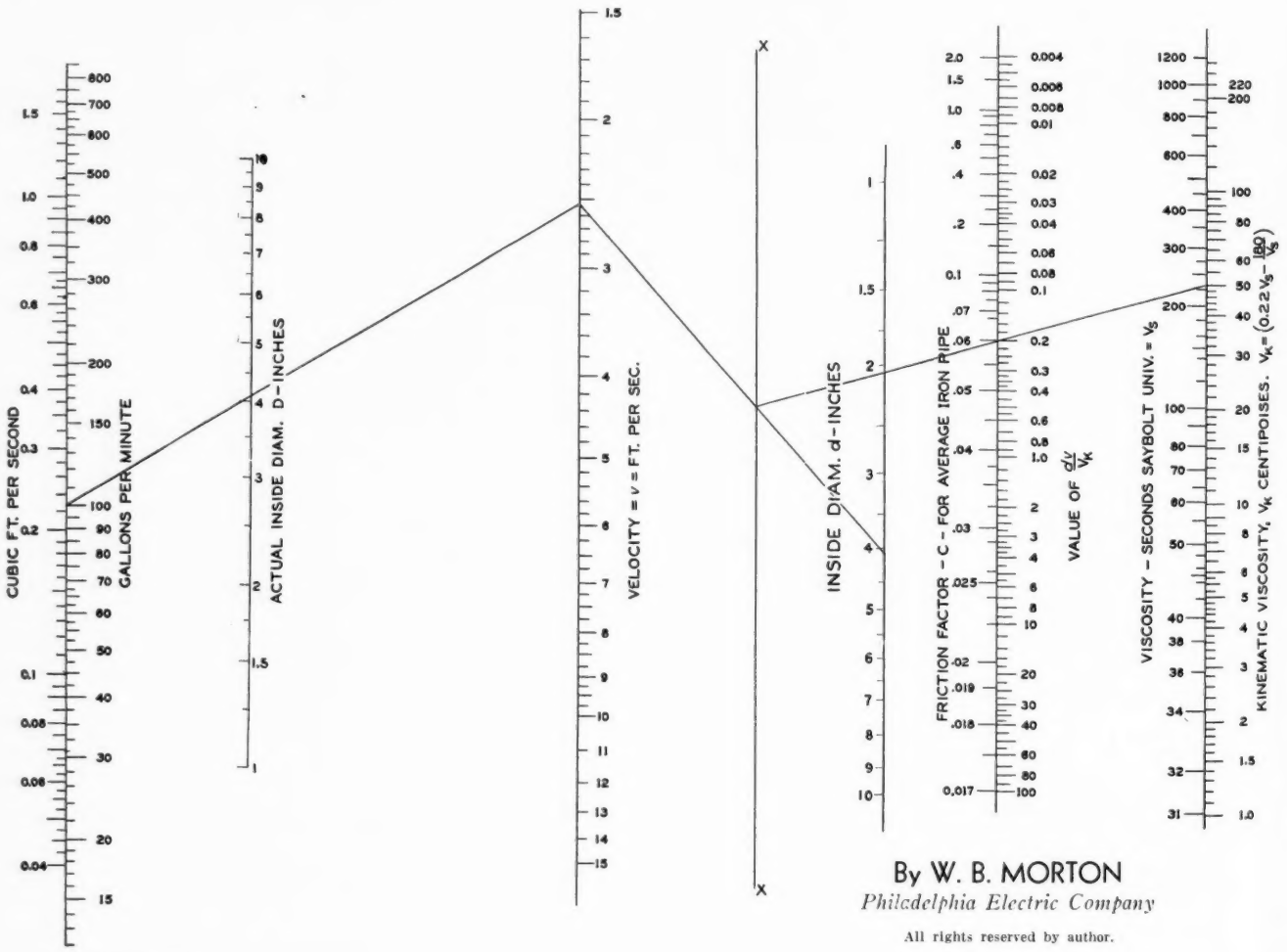
The chart is designed to aid in calculating friction head. From it may be obtained the flow velocity and friction coefficient when quantity of oil flowing, viscosity and pipe diameter are known.

Example: What is the friction head per 1,000 ft. of pipe having an inside diameter of 4.09 in., when 100 gal. per minute of oil having a viscosity of 230 sec. Saybolt is flowing? The velocity of the oil is first found by drawing a line from 100 gal. per minute on the left-hand scale through 4.09 on the scale of inside pipe diameter. This intersects the velocity scale at a point equal to 2.53 ft. per sec.

To find the friction factor, a line is drawn from 2.53 ft. per sec. on the velocity scale to 4.09 in. on the scale marked "inside diameter d — inches," and intersecting the blank scale X. From the intersection on the blank scale a line drawn to 230 on the viscosity scale at the right intersects the friction factor scale at 0.06. Substituting the values found in the equation for friction head:

$$h_f = \frac{0.06 \times 1{,}000 \times 2.53^2}{0.34 \times 64.4} = 17.5 \text{ ft.}$$

The specific gravity of the oil is 0.91, and the pressure corresponding to the head is $P = 0.433 \times 0.91 \times 17.5 = 6.9$ lb. per sq.in.


CUBIC FT. PER SECOND
GALLONS PER MINUTE
ACTUAL INSIDE DIAM. D - INCHES
VELOCITY = v = FT. PER SEC.
X
X
INSIDE DIAM. d - INCHES
FRICTION FACTOR - C - FOR AVERAGE IRON PIPE
VALUE OF $\frac{dV}{V_k}$
VISCOSITY - SECONDS SAYBOLT UNIV. = V_S
KINEMATIC VISCOSITY, V_k CENTIPOISES. $V_k = (0.22V_S - \frac{180}{V_S})$

By W. B. MORTON
Philadelphia Electric Company

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©Power

CASHMAN LAUNDRY
GENERATES OWN POWER FROM PROCESS STEAM

STEAM and power for the new and thoroughly modern Cashman laundry, located in New York City near the Harlem River, is supplied from a power plant within the laundry building. The relation between steam and power requirements is such that the entire power demand can be generated as a byproduct of the steam required to operate the laundry equipment. In fact, the engine exhaust is generally insufficient and has to be augmented by live steam through reducing valves.

The laundry is designed to do an ultimate business of $50,000 weekly, which requires that 300,000 lb. of laundry be handled each week. The washing equipment to care for the weekly load has capacity to wash 12,125 lb. of laundry for each loading of the machines. The washers use 2.6 gal. of water at 180 deg. per lb. of wash, so that for each loading of the machines 31,550 gal. of hot water are required. Ninety minutes is required to complete the washing process, making the hourly demand for hot water 21,000 gal.

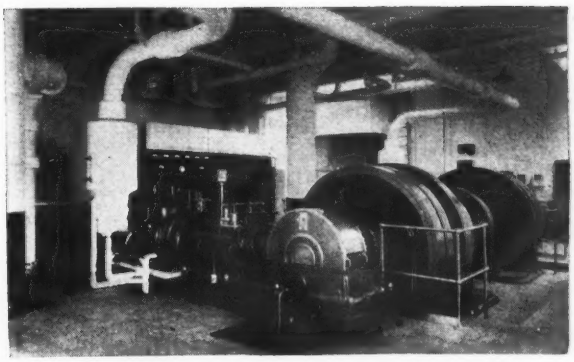
To heat this amount of water from 50 deg. with steam at about 5 lb. pressure requires about 23,000 lb. of steam an hour. Other process steam required for ironing machines, dryers, etc., amounts to 11,426 lb. per hour, making the total requirements for steam 34,426 lb. per hour.

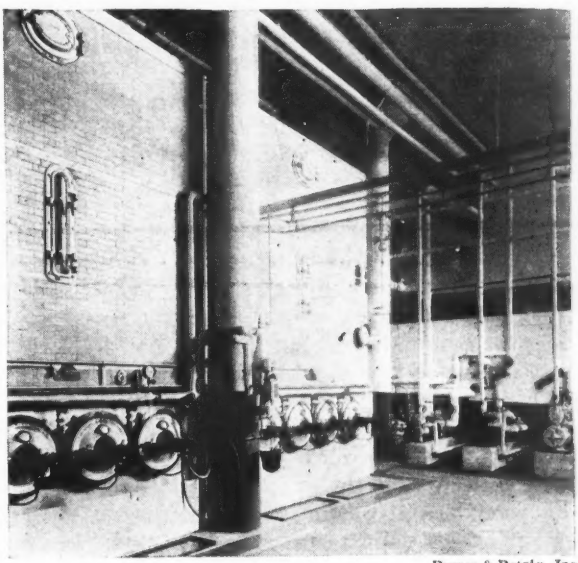
The total connected motor load in the laundry amounts to 244 kw. Assuming a load factor of 70 per cent, the average demand would be for 170 kw. With 150-lb. initial steam pressure, 170 kw. can be generated with a steam flow of about 5,600 lb. per hour when exhausting against 5 lb. back pressure. This amount of exhaust is only about one-fourth the required low-pressure steam. Even a peak load of 244 kw. would yield only about 8,000 lb. of exhaust.

The power plant occupies a floor space 50 ft. by 100 ft. at one end of the laundry building. The engine room is on the street level, while the boiler room (or perhaps more accurately, the boiler operating floor level, as there is no dividing wall between the boilers and the engines) is depressed about 10 ft. Two 4,440 sq.ft. low-head type Stirling boilers deliver steam at 150 lb. pressure to two uniflow engines rated at 175 kw. each. Fuel oil is used in four pressure atomizing burners per boiler. These have sufficient capacity to produce 150 per cent of rating.

The boiler foundations presented a somewhat unusual problem inasmuch as part of this foundation is on rock and part on ground filled into the Harlem River. Piles 40 to 50 ft. long were driven to provide proper footing for this part of the plant.

A feature is the neat and convenient arrangement of the main steam piping. Steam leads from both boilers connect separately to a 12-in. welded header at the end of the engine room nearest the boilers at such height that the valves in the connecting piping are at easy operating level. From the header two 5-in. lines deliver steam to the engines, and another delivers steam through a reducing valve to the laundry at 100-lb. pressure.





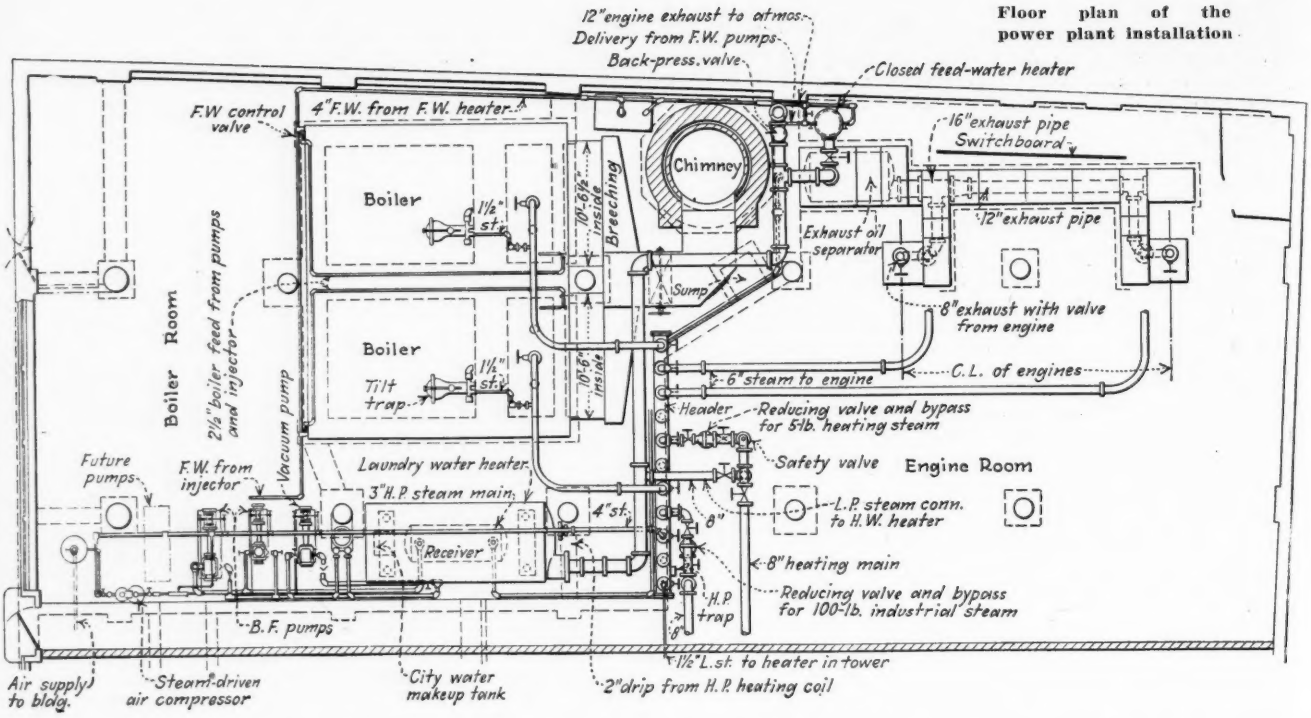
Peyser & Patzig, Inc.

The above views of the engine and boiler installation show the neat arrangement of equipment and excellent natural lighting

Connections are also made for 150-lb. steam to auxiliary drives and to a reducing valve which supplies 5-lb. steam to the low-pressure line, which also receives auxiliary and main engine exhaust after it has passed through oil separators. Steam for heating the building during the winter is also taken from this source.

Low-pressure steam is used in a closed feed-water heater of 51,750 lb. per hour capacity and in a storage type heater that supplies hot water to the laundry. The latter heater is copper lined and has sufficient volume to store about 35,000 lb. of water, sufficient for one loading of the washing machines. This heater is supplemented by an instantaneous type heater.

Directly under the laundry-water heater is a receiver



Floor plan of the power plant installation

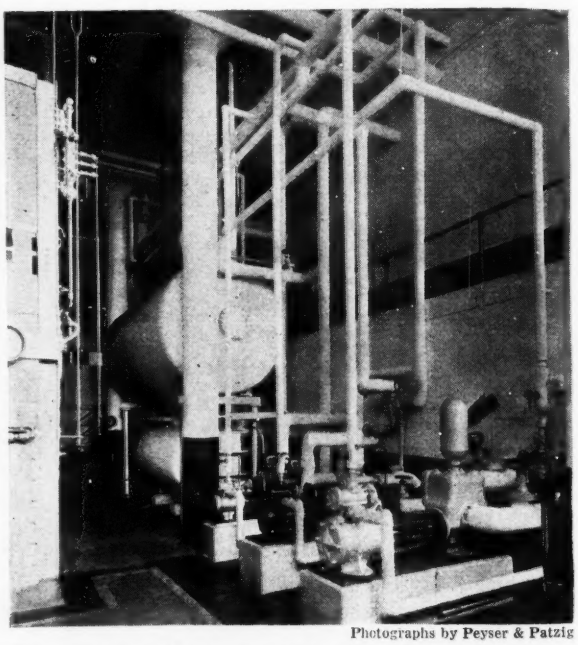
tank to which is delivered the condensate from the laundry-water heaters, condensate from the feed-water heater, drips from the steam mains and returns from the heating system which, however, first pass through a 6x8x10-in. simplex vacuum pump.

Make-up water from the city main is admitted to the receiver tank without treatment under control of a float valve actuated by the water level in the receiver. The float of this valve is placed in a chamber outside the receiver tank to prevent its being effected by the turbulent conditions of the water in the receiver, and is set low to accommodate the excessive condensate that collects when starting the laundry in the morning.

Two double-acting, single-cylinder feed pumps, one 10x7x12 in., the other 7½x5x10 in., take water from the receiver and deliver it through an oil strainer, feed-water heater, and hand-controlled feed valves to the boilers. A steam injector has been provided in addition to the two feed pumps. To insure quick heating up of ironers and other laundry apparatus traps have been omitted on all of the laundry equipment. The returns are piped to a receiver tank located on the second floor. This, in turn, is interconnected with tilting traps (located over each boiler), which discharge the condensate collected in the receiver directly to the boiler drums. The steam condensing capacity of the laundry apparatus eventually to be connected to these traps is 13,000 lb. an hour. Each of the two traps installed has a capacity of 9,000 lb. per hr. They return the condensate to the boiler under pressure, thereby eliminating any heat loss due to flashing.

The two 19x20-in. uniflow engines operate at 225 r.p.m. and are each rated at 280 hp. they are connected to 250-kva., 0.8-power factor, alternating-current generators with belt-driven exciters. The switchboard is placed along the wall at the head end of the engines, convenient to the engine throttle valves to facilitate synchronizing the generators.

Except for a few cast-iron radiators in the office space, all of the laundry building heating is done by unit heaters. These are placed along the walls in such a manner that the heated air is blown into the work spaces. Because of the large amount of steam-heated equipment, a relatively small amount of heating has to be done. For this reason the heating system was designed on the basis of heating only to 50 deg. during zero weather. All unit heaters are equipped with thermostatic traps, the returns being delivered to the vacuum pump in the power house.



Photographs by Peyser & Patzig

The laundry water heater and below it the condensate receiver are shown behind the plant pumping equipment

As an economy measure, heat-exchange equipment has been installed in the laundry wash room and the dirty hot water from the washers is pumped through it before being discharged to the sewer. This water raises the temperature of the city water make-up 20 to 30 deg.

Information for the preparation of the article was obtained through the courtesy of S. H. Cashman, owner, and R. G. and W. M. Cory, the architects and engineers.

Table of Equipment—Cashman Laundry Power Plant

Boilers, 2 Low-head Stirling 4,440-sq.ft. heating surface, 150-lb. working pressure.....Babcock & Wilcox Co.
Setting; fire brick, air-cooled furnace floor, Frederick Page Contracting Co.
Oil burners, 4 per boiler and auxiliary oil equipment, Todd Combustion Equipment Inc.
Soot blower.....Diamond Power Specialty Corp.

PUMPS

Fuel oil pumps, two 5½x3¾x5-in. duplex.....Dean Hill Pump Co.
Boiler feed pumps one 10x7x12-in. and one 7½x5x10-in. double-acting single-cylinder.....M. T. Davidson Co.
Vacuum pump, one 6x8x10-in. simplex.....M. T. Davidson Co.
Hotwater circulating pump, one 500-g.p.m., 50-ft. head centrifugal, 15-hp. motor drive.....M. T. Davidson Co.
Air compressor, steam-driven, 150 cu.ft. per min., 131 strokes per min., cross-compound, 85-lb. pressure, Westinghouse Electric & Mfg. Co.
Heat reclaimer sump pump, two 250-g.p.m.....M. T. Davidson Co.
Boiler-feed injector, one 2½ in. Metropolitan Type O, Consolidated Ashcroft Handcock Co.

HEAT EXCHANGERS

Feedwater heaters, 51,750 lb. per hr.....Cochrane Corp.
Laundry water heaters, one storage type heater, 80 in. dia. 17 ft. long, 675 sq.ft. heating surfaces, 1¼-in. tubes copper-lined, one instantaneous type 23 in. dia., 147 in. long, 500-sq.ft. heating surface, ¾-in. tube..Patterson-Kelley Co.
Heat reclaimer, 43 in. dia., 120 in. long, 1,250-sq.ft. heating surface 1¼-in. tubes.....Patterson-Kelley Co.
Engines—2 Unaflow 19x20-in., 280-i.hp.....Skinner Engine Co.
Generators—2 direct-connected, 250-kva. 8-p-f..General Electric Co.
Switchboard .....Empire Switchboard Co.

VALVES, FITTINGS, TRAPS AND PIPE

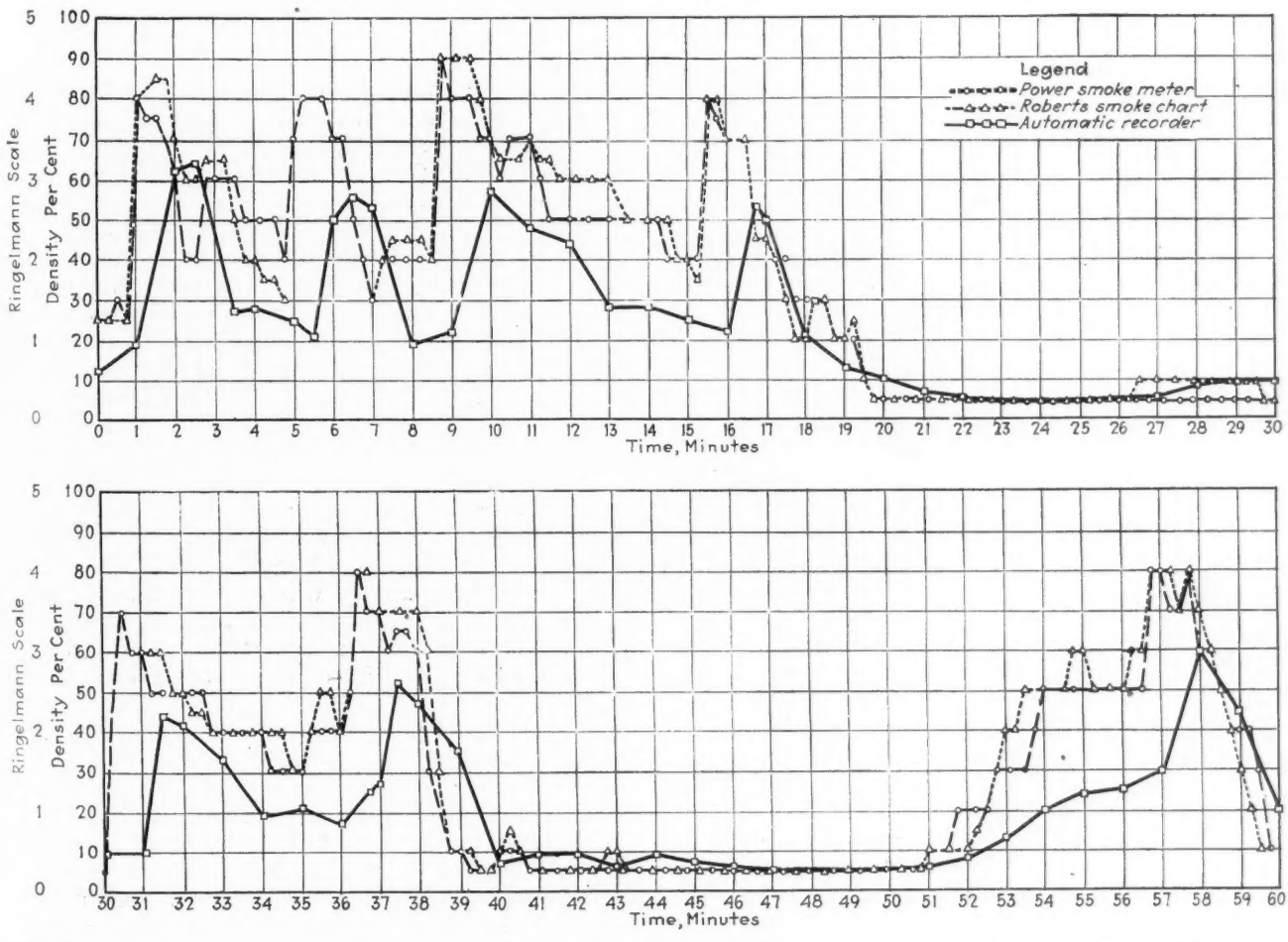
Blow-down valves .....Barrett Machine Co.
Gate and Globe valves.....Lunkenheimer Co.
Tilt traps, two, 9,000 lb. per hr. each.....Bundy Steam Trap Co.
Thermostatic traps .....Warren Webster & Co.
Drainers .....Cochrane Corp.
Drip traps .....V. D. Anderson Co.
Pipe, wrought iron .....A. M. Byers Co.
Pipe erected by.....Almirall & Co.
Pipe insulation, 85% magnesia.....R. A. Keasbey Co.

MISCELLANEOUS

Unit heaters .....Modine Mfg. Co.
Feed water oil later.....Blackburn Smithing Mfg. Co.
Exhaust Oil-separator .....Cochrane Corp.
Stack.....M. W. Kellogg Co.
Breeching.....Coatesville Boiler Works
Temperature recorder .....Foxboro Co.
Pressure recorder .....Consolidated Ashcroft Hancock Co.
Steam Pressure Controller.....Locke Regulator Co.

▼ ▼ ▼

SMOKE CHARTS COMPARED



THE purpose of the records above made by H. E. Baumgardner, Detroit Edison Co., was to compare the readings made with two types of visual smoke charts with the records of a recording smoke meter. For test purposes the boiler was caused to smoke more than normally.

As would be expected, the two series of visual readings agree closely, while the automatic recorder, operating on a different principle, differs somewhat, with a slight evidence of lag. The break of continuity in readings of the Roberts chart at the five-seven minute period shown on the upper chart was due to temporary trouble.

The charts show clearly that all records rise and fall together within reasonable limits and that the time lag of the recorder rarely exceeded one minute.

LONGER LIVES for CONVEYOR BELTS

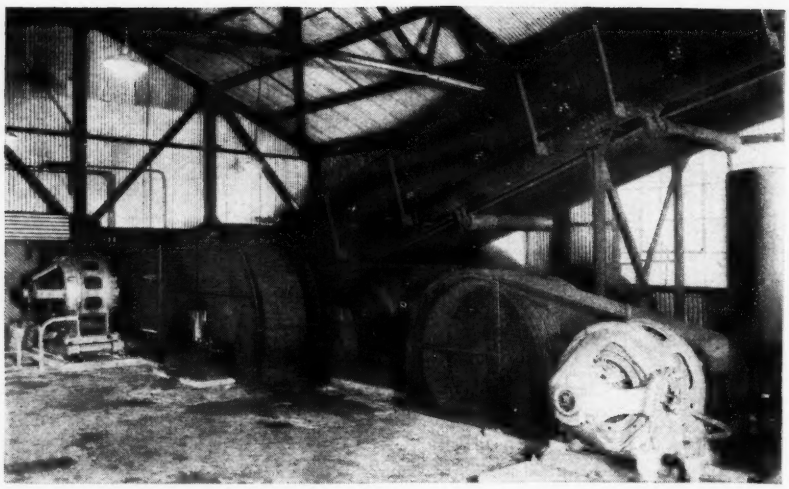


Fig. 1—A 250-hp. and a 75-hp. wound-rotor motor drives this 750-ton per hr. belt conveyor

On a belt conveyor, the cost of the belt often equals that of all other parts combined. Whether cost is one cent or one-tenth cent per ton depends on how the belt is installed and operated

SINCE, on a belt conveyor, the cost of the belt may equal that of all other parts, care should be taken both in design and operation to prolong its life. In this the design of the chute to deliver the load to the belt is one of the most important factors. A loading chute should be so designed that the material will be delivered to the belt in the direction of its motion, and at the same speed, so that there will be as little slippage as possible between material and belt. Many conditions, such as kind of material, angle at which the conveyor operates and other factors prevent complete elimination of slippage in loading the belt.

For heavy material with fines, it is good practice to place a screen at the bottom of the loading chute. The screen allows the fines to flow through onto the belt to form a cushion for the lumps when they come off the end of the chute. Where this method of loading is used, the screen should be watched, as it tends to clog and thereby reduce the flow of material to the belt. Slowing up of the material has two bad effects: First, material delivered too slowly to the belt must be accelerated, causing abrasion. Second, the belt is operated at reduced capacity, resulting in increased wear at its center and increased cost per ton of material handled.

Skirt boards should extend along the conveyor far enough to prevent material from jumping off the belt when being loaded. These boards should be substantially supported a few inches above the surface of the belt, and are frequently edged with a strip of rubber belting to prevent fines from being spilled. The boards should be watched to see that they do not get out of adjustment or in any way come in contact with the belt surface.

Troughing rolls should be spaced more closely under the belt at the loading chute than along the normal run of the belt. They should be so placed that the load comes on the belt between two rolls so as to cushion the impact and reduce its abrasive effect.

Idlers on which the belt runs are next in importance to loading in the life of the belt. Spacing of the troughing idler depends upon the weight of the material and width of the belt. Good practice for coal is spacing varied from 5 ft. for a 14-in. belt to 3 ft. 6 in. for a 48-in. belt. If the idlers are too far apart the load tends to flatten out the belt between them and subjects it to excessive bending. The load is continually rubbing on the parts of the belt running over the troughing rolls and causes reduced life by abrasion. Too few troughing idlers also increase the power required to drive the belt. A test on one conveyor showed that increasing the troughing-idler spacing from 3.5 to 7 ft. increased power consumption 20 per cent.

When the belt leaves the troughing idlers and runs over the head pulley it changes from a trough to a flat form. Unless the head pulley is properly located with relation to the troughing idlers severe stresses may be put in the sides of the belt. The location of the head pulley is determined to a degree by local conditions, but one rule is to place its top surface a distance equal to about one-third the trough depth above a line tangent with the bottom of the trough. If the trough is 3 in. deep, then, the head pulley is located 1 in. above a line tangent to the top of the horizontal rollers.

Idlers may be had equipped with either sleeve or anti-friction bearings. Those equipped with anti-friction bearings are now finding wide application. Although their cost may be from 50 to 100 per cent higher than those with sleeve bearings, their many advantages make their use economical. Less power is required to drive the conveyor. Tests have shown that this saving may be as great as 45 per cent of the total power required for operating the conveyor with sleeve bearings, with a corresponding reduction in the driving motor's size. A lighter belt may be used. It is not only less expensive, but being more flexible, will probably have a longer life than the heavier one required with sleeve-bearing idlers. There is less danger of the anti-friction idlers sticking and injuring the belt, and they require only a small part of the attention for inspection and lubrication necessary for sleeve-bearing types.

Small-size conveyors are driven directly from the head pulley. On the larger-size conveyors sufficient traction

cannot generally be obtained on the head pulley, and a tandem drive is used, on which the belt laps around two drive pulleys. Since these pulleys are geared together they must be identical or the belt will have to slip on one of them. This will cause wear on the belt and loss of traction on the pulleys and an increase in power to drive the conveyor.

On some large conveyors tandem drives are used that have a motor on each of the two drive pulleys. This allows a certain flexibility between the two pulleys. It also allows locating these pulleys so that the belt makes easier bends between them than are possible with two pulleys geared together. These improved conditions are favorable to increased life of the belt, but the high cost of the two-motor drive limits its use to the larger installations.

The belt should run centrally along the entire length of the conveyor or it may be seriously damaged along its edges, as indicated in Fig. 2. For use where difficulty is experienced in having the belt train properly on the return idlers, a trainer roll has been developed that automatically keeps it running straight.

Fig. 2—This is what can happen to a conveyor belt if its edges rub on stationary parts

Tandem drives, automatic trippers, and automatic takeups put reverse bends in the belt, which tend to reduce its life, but how much they reduce it is a question open to discussion. It is the opinion of some authorities that the effect of reverse bends in a belt, at least up to a certain number, has been over-estimated.

The quality of the belt is an important factor in the service that it renders. With the exception of temporary installations or those that are used infrequently, the best conveyor belt offers the greatest ultimate economy. As an example, on a conveyor where a low-price belt was installed its price represented a cost of 0.6 cent per ton for handling coal. When this wore out it was replaced by a high-grade belt that gave more than three times the service of the former. Its price represented a cost of 0.2 cent per ton of coal handled. The belt cost for handling coal will vary with conditions, but a fair average is about 0.2 cent per ton, with a minimum as low as 0.1 cent.

When the belt is being installed its ends should be cut perfectly square, using a steel square. Punch the holes in the belt accurately and do not make them too large. Rivets or lace must fit the holes snugly and must hold the belt ends closely together. Rubber cement should be used on the ends of the belt and in the holes to prevent moisture from getting into the fabric.

Material should not be allowed to accumulate where it will rub on the belt or the idlers, also the surface of the belt should be kept clean. Where there is a tendency for coal to stick to the belt, a brush of either the revolving bristle or fluted-rubber type should be installed to keep it clean.

The conveyor must be regularly inspected at least once a week and the condition of the belt and its idlers and pulleys checked. An accumulation of dirt on an idler or pulley should be immediately removed, as these subject the belt to unnecessary wear. If the belt's surface is injured, it should be repaired at once. The damaged place should be cleaned thoroughly with gasoline and then with alcohol to remove any surplus moisture, then filled with a rubber cement. This protects the canvas body and prolongs the life of the belt. Careful attention should be given to the decking between the two strands to see that it has not been damaged so that it allows material to fall on the under strand and be carried between the belt and pulleys. Belts have been seriously damaged from this cause.

For the weekly inspection the conveyor should be run empty, with the belt moving past the attendant. He must inspect both its surfaces for indications of injury or of oil getting on it.

After the surfaces of the belt have been inspected, the attendant should walk the length of the conveyor and look for any unusual movements in the surface of the belt. Removably mounted idlers have been known to rise up out of their fastenings and operate that way until the belt was injured before the fault was discovered. This trouble is something that should be easily located on the regular period of inspection.

Squeaking idlers should be listened for on the inspection trip up the conveyor. A squeak indicates lack of lubrication and should be immediately corrected. Also note whether all idler rolls are running freely. If any show signs of sticking, this should be corrected by increased lubrication or by dismantling the idler to ascertain the cause.

Lubrication of Idlers

How frequently the idlers should be lubricated is governed by several factors. Where idlers have sleeve bearings lubricated with grease cups and the conveyor is in daily use after the idlers have once been well lubricated, giving the cups a half turn twice a week should keep the bearings in good condition. Where Alemite fittings are used a shot of grease once a week is generally sufficient. With anti-friction bearings, lubrication once every three to six months is all that is required.

Not all the factors that influence a conveyor's belt life have been included in the foregoing. However, those that have been discussed show that there are just as many opportunities for the exercise of vigilance and good judgment in the maintenance of belt conveyors as with any other piece of equipment. It is also evident that the cost of handling coal is in a large measure dependent on the quality of design and care of the conveyor system.

Acknowledgment is here made to W. L. Fewsmith, engineer, Robins Conveying Belt Company, for his assistance in the preparation of this article.

WHAT IS A GOOD OIL FOR STEAM CYLINDERS

By JAMES I. CLOWER
Ass't Prof., Machine Design
Virginia Polytechnic Institute

Correct selection and use of cylinder oil is one of the important responsibilities of engine operation. The author relates choice of oils to engine size, steam temperature, load and speed

BEARING lubrication is one problem; lubrication of reciprocating engine parts exposed to steam is another. Cylinders, valve rods and piston rods must operate with a less complete oil film than is obtainable in high-speed journal bearings.

Unlike the bearing, the steam cylinder cannot be flooded with oil for obvious reasons. At the high temperatures generally encountered, it is not even possible to maintain films thick enough to prevent metal-to-metal contact. The next best thing is to provide highly polished contact surfaces and to coat them with as complete a film as is practicable. To this end the oil must be carefully selected for viscosity or body, percentage of compounding, stability and certain other characteristics.

Six factors—steam pressure, temperature, quality, engine load, size and speed—affect lubrication, and therefore the choice of a suitable oil. This article will show how these factors enter into the problem, and will present a table designed to assist the engine operator in selecting the right oil.

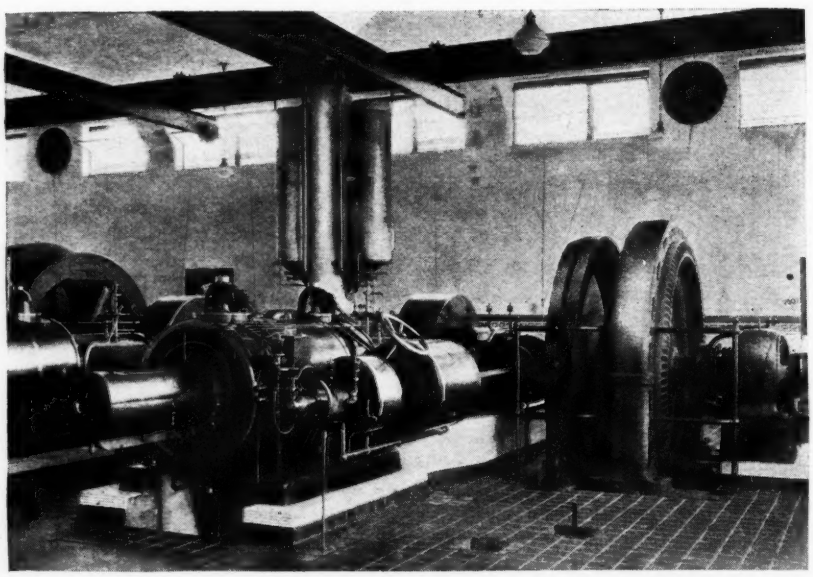
Oil Must Have Three Qualities

A good steam cylinder oil must possess three qualities under the conditions of its applications:

First, the oil must spread uniformly over all internal friction surfaces. If applied through an atomizer in the steam pipe the oil must be capable of minute atomization so that it will be carried by the steam to all parts of the valve and cylinder requiring lubrication. Oil applied directly to the cylinder walls must spread easily under the stroking action of the piston.

Correct oil body or viscosity is the prime requisite of an oil for either of these methods of application. To a lesser degree, percentage of compounding and extent of filtration also influence distribution, because of their effect upon surface tension with respect to metal and upon oil cohesion. The process of filtration removes some of the hydrocarbons which make the oil cohesive, and it is then possible to regulate the feed more closely, especially if a hydrostatic lubricator is employed.

The second quality desired is economy, the ability to maintain effective lubricating and sealing films with small consumption. Here, again, oil viscosity and percentage of compounding are the important oil properties involved, and they must be considered in connection with steam temperature and the washing effect of wet steam upon the oil film.



Whether in Corliss, 4-valve or uniflow engine, lubrication of reciprocating parts exposed to steam is of vital importance

Third, steam cylinder oils must be stable, chemically and physically. Exposed to hot air, as thin films, some oils oxidize rapidly, forming gummy masses which are useless as lubricants. Cheap compounds in oil may change chemically to form free fatty acids, causing serious corrosion and pitting.

Still other oils, cheap or unsuited for the operating conditions, may suffer destructive distillation, forming carbon deposits which freeze the rings.

Volatility, especially under high-temperature condi-

tions, is very important. Because of volatility, more oil is required at high temperature than at low. Flash point, by the way, is not a direct measure of the volatility of an oil. This property depends mainly upon the composition and relative amounts of various hydrocarbons.

The pressure, temperature and quality of the steam must be considered when selecting cylinder oil. High pressures produce high ring pressures, tending to scrape the film of oil off the cylinder wall where it is most needed. On the other hand, there is more turbulence in the cylinder with high-pressure steam, which tends to produce better oil distribution. Both of these factors point toward the use of a comparatively heavy bodied oil for high pressure (that is to say, any pressure over 100 lb.). Low steam pressure, conversely, calls for light-bodied oil.

Effect of Steam Temperature Marked

The effect of steam temperature is marked. Viscosity decreases rapidly as temperature rises; high-temperature oil is more fluid. While a fluid oil distributes readily and uniformly, the resulting film is thin and weak, incapable of sustaining heavy pressures.

High temperature reduces surface tension; hence a hot oil will form smaller globules than a relatively cold oil. As a result, more completely atomization is secured, and more thorough distribution. High temperature increases the tendency of the cylinder oils to carbonize and decompose, with the resulting clogging of rings and valves. Pistons, cylinder walls, valves and valve seats may be scored by small fragments of these deposits.

Except for carbonization, all of these factors call for a high viscosity oil containing a relatively small proportion (from 3 to 5 per cent) of acidless tallow compounding. The small percentage of compounding is necessary to combat the moisture generally present during the exhaust stroke. Obviously, low temperature calls for a comparatively light bodied oil, correctly compounded to resist moisture.

The Effect of Steam Quality

Wet steam, which is usually accompanied by low pressure and temperature, tends to wash away the film, thus necessitating the use of a strongly compounded oil. Water has a slightly greater affinity for metal than has oil, and it is difficult to make pure mineral oil adhere to a water-wet surface. If water is dashed against an oil-wet metal surface the oil film is readily washed off.

For compounding the general practice is to use acidless tallow oil or raw or prepared degras. The amount of compounding depends upon the amount of moisture present, but rarely exceeds 10 per cent. Usually, 5 or 6 per cent is enough, 3 or 4 per cent may be sufficient where little moisture is present. The table gives correct percentage of compounding for various operating conditions.

Engine characteristics influencing lubrication are load, size and speed. Engineers often forget the importance of load in this connection. It has a direct effect upon cylinder temperature, the quantity and quality of the steam, and the turbulence which determine distribution.

Engines operating at 75 per cent of rating, or more, are easily lubricated. At light loads there are wider temperature variations, and a smaller volume of steam for distributing a heavy-bodied cylinder oil.

Cylinders above 24-in. bore have comparatively thick walls, and use a large volume of steam per stroke. These result in high temperature and call for a heavy-bodied oil. Smaller cylinders require oils of lighter body.

Engines operating at constant speed are easier to lubricate, because the lubricator can be given the best setting for that speed. Slow-speed engines operate at lower temperatures and give more time for the distribution of the oil. Thus higher speed engines require quick-acting light-bodied oils.

We then have six factors to be considered: Steam pressure, temperature, quality, engine load, size and speed. For each combination of these factors there is generally one type of cylinder oil that will produce the best results.

Rates of Feed for Steam Cylinders

Even with correct oil, deposits may lead eventually to operating difficulties, unless the oil feed to the cylinders is properly adjusted. By studying the requirements of their units, engineers can adjust lubricators for efficient lubrication with minimum deposits.

With mechanical forced-feed lubricators the feed can be controlled very closely, but it should be checked periodically, and adjustments made as necessary.

Table 1 is a guide to the oil requirements of steam cylinders. Conditions may warrant certain variations from these rates, and operators must satisfy themselves in regard to the correctness of their feeds by close observation from time to time.

Table II aims to cover all normal operating conditions. Manifestly, there are operating conditions that are abnormal. These are not included in the table. Selection of the correct oil for these rare exceptions requires special consideration by a competent lubrication engineer.

TABLE I—APPROXIMATE RATES OF FEED FOR STEAM CYLINDERS

Size of Cylinder	Pints per 10-Hour Day
8x8	0.50
12x12	0.75
18x18	1.50
24x24	2.00
30x30	2.50
36x36	3.00
42x42	3.75

TABLE II — GUIDE TO SELECTION OF STEAM CYLINDER OILS

Steam Properties			Engine Characteristics			Specifications for Oils							
Pressure Lb. Gage	Temperature Deg. F.	Quality	Load	Stroke	Speed R.p.m.	Per Cent Compound	SP. GR.	Pour Deg. F.	Flash Deg. F.	Fire Deg. F.	A.S.T.M. Viscosity 104 Deg.	140 Deg.	210 Deg.
Over 100 lb.	Over 600 °F.	Superheated.	Over 75%	Any	Any	5	910	35	610	680	3260	1000	210
Over 100 lb.	Over 600 °F.	Superheated.	Under 75%	Any	Any	5	905	40	495	545	1150	424	108
Over 100 lb.	Less than 600 °F.	Dry or sup'ed.	Over 75%	Any	Any	5	905	40	540	600	1700	576	140
Over 100 lb.	Less than 600 °F.	Dry or sup'ed.	Under 75%	Over 24"	Any	5	905	40	495	545	1150	424	108
Over 100 lb.	Less than 600 °F.	Dry or sup'ed.	Under 75%	Under 24"	Any	10	910	35	485	545	1040	360	94
Over 100 lb.	Less than 600 °F.	Wet	Over 75%	Over 24"	Any	6	905	40	540	600	1645	555	135
Over 100 lb.	Less than 600 °F.	Wet	Over 75%	Under 24"	Over 125 r.p.m.	10	910	35	485	545	1040	360	94
Over 100 lb.	Less than 600 °F.	Wet	Over 75%	Under 24"	Under 125 r.p.m.	6	905	40	540	600	1645	555	135
Over 100 lb.	Less than 600 °F.	Wet	Under 75%	Over 24"	Any	6	905	40	540	600	1645	555	135
Over 100 lb.	Less than 600 °F.	Wet	Under 75%	Under 24"	Any	10	910	35	485	545	1040	360	94
Under 100 lb.	Less than 600 °F.	Wet	Over 75%	Over 24"	Any	10	910	35	485	545	1040	360	94
Under 100 lb.	Less than 600 °F.	Wet	Over 75%	Under 24"	Over 125 r.p.m.	10	910	35	485	545	1040	360	94
Under 100 lb.	Less than 600 °F.	Wet	Over 75%	Under 24"	Under 125 r.p.m.	6	905	40	540	600	1645	555	135
Under 100 lb.	Less than 600 °F.	Wet	Under 75%	Any	Any	10	910	35	485	545	1040	360	94

DOWTHERM BOILER
SUPPLIES VAPOR FOR HIGH-TEMPERATURE PROCESS

By G. A. YOCUM
Chief Engineer, Dow Chemical Co.

DOWTHERM is the name given to mixtures of diphenyloxide with diphenyl or other phenolic and benzol derivatives made by Dow Chemical Co. Its thermal properties are such that it can be employed advantageously as a heat transfer medium at temperatures of 500 to 700 deg. F. and at corresponding low pressures of zero to 100 lb. gage.

To use the chemical mixture, Dow has installed at its Midland (Mich.) plant a boiler specially designed by the Foster Wheeler Corp. for this service. It delivers to the chemical plant Dowtherm vapor at 646 deg. F. and 50.3 lb. gage pressure for use in the distillation of high boiling point chemical compounds.

The boiler is designed for a normal heat output of 4,000,000 B.t.u. per hour, and is arranged for upward vertical oil firing by a single burner located at the bottom of the combustion chamber.

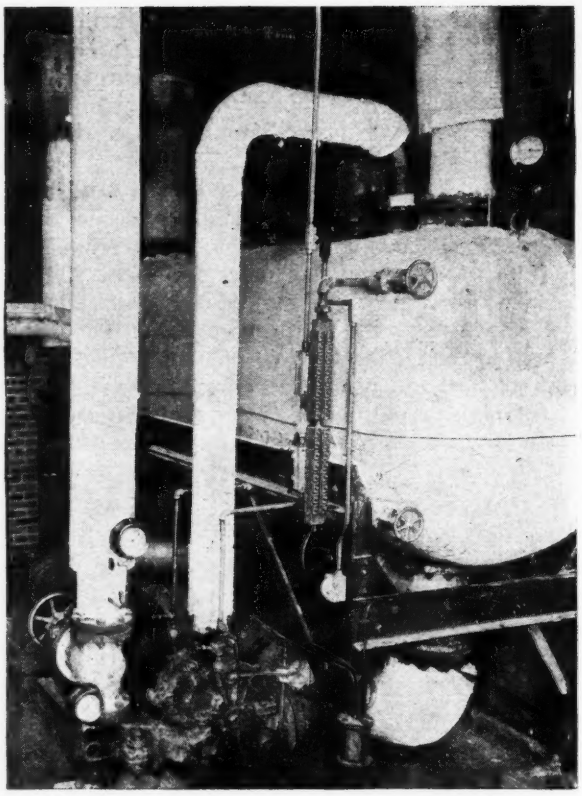
The furnace is square in cross-section and lined on all four sides with coils which act as the radiant heat-absorbing surface. These coils, connected to an external common header, receive Dowtherm liquid from the liquid circulating pump and discharge to a second header that supplies a series of multi-loop connection elements. Both radiant and connection elements consist of 2-in. O.D. carbon steel tubing.

The liquid circulating pump is of about 600 gpm. capacity, which is sufficient to produce a liquid velocity of 3 ft. per sec. in the boiler tubes.

Electrical interlocking is provided so that the fuel oil pump cannot be operated unless the circulating pump is in operation. Thus the boiler is protected against burnouts due to interruption of the circulating pump. The liquid and vapor mixture from the convection section is collected in a top external header and delivered to the top of a 4-ft. dia. by 12-ft. long drum which serves to separate the vapor and liquid and also as a reservoir for the liquid circulating pump. The vapor line leading to the heating apparatus is taken off the top of the vapor drum, and return condensate is brought back to a connection near the bottom of the drum.

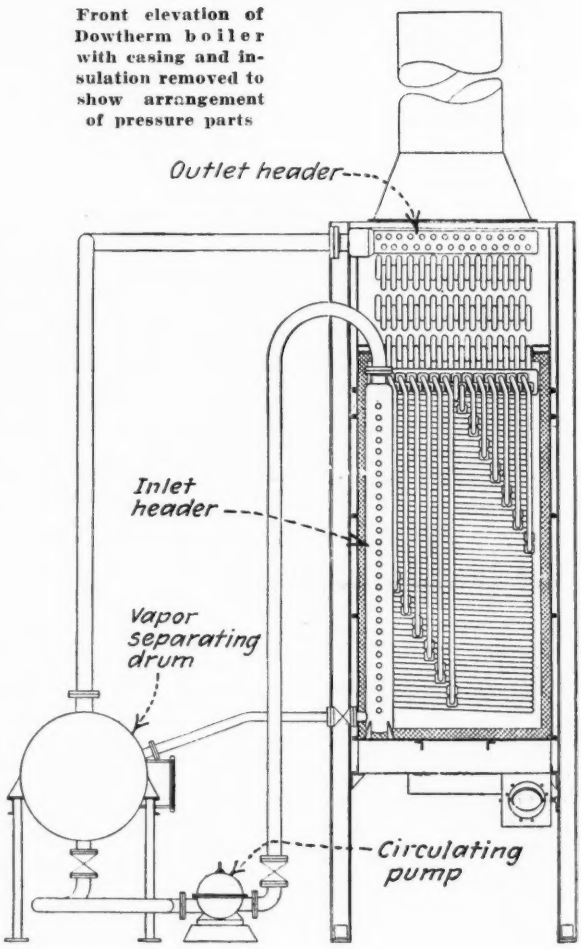
Forced circulation of the liquid Dowtherm permits location of the drum below the boiler so that the entire boiler will drain back into it during shut-down periods.

The two 4-in. safety valves on the drum are set to open at 100-lb. pressure. As the normal operating pressure is only about 50 lb. this setting insures that there will be practically no loss of Dowthern due to popping of safety valves. In addition, the fuel oil pump is provided with a pressure-actuated electrical cutout which shuts off the burner before the pressure reaches the setting of the safety valves.



Boiler drum and Dowtherm circulating pump are below the boiler proper

Front elevation of Dowtherm boiler with casing and insulation removed to show arrangement of pressure parts



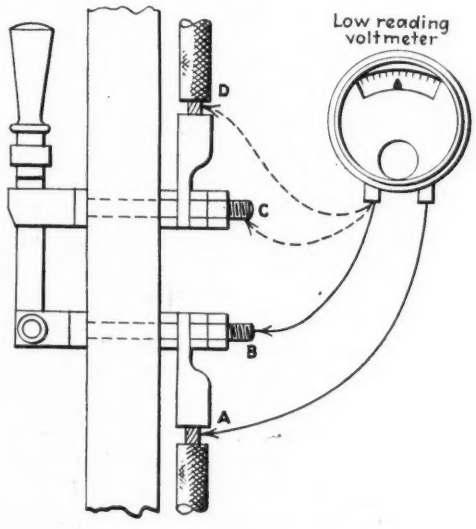
PRACTICAL AIDS TO OPERATION

Poor Connection Caused Generator To Shirk Its Load

A DIRECT-CURRENT generator that had operated satisfactorily for several years developed a tendency to shirk its load. When the operating engineer failed to find the cause, he called in several electrical engineers who did not solve the problem. One morning while the engineer was back of the switchboard, he discovered a corroded connection on the generator switch. When this was cleaned and tightened the generator gave no further trouble.

This is a simple fault and should be quickly located by any competent electrical-machinery trouble shooter. One of the first things to have done would have been to check the generator and switchboard connections to see if they were in good condition. After the generator had been loaded for a while the difference in the temperature of the connctions should have revealed any faulty ones.

A test could have been made with a low-reading voltmeter as indicated in the figure. On the switch, readings should have been taken, when the load was on the generator, between points *A* and *B*; *B* and *C*; *D* and *C*. Reading from *A* to *B* and *C* to *D* would indicate how well the cable connections were made to the lugs and the lug to the switch. Reading from *C* to *D* would give the drop through the switch clips. On a two-pole switch or two single-pole switches carrying the same current, a reading could be taken from *A* to *D* on each pole and one compared with the other. These readings should be



practically equal and only a fraction of a volt. Any irregularities in them should be investigated and corrected.

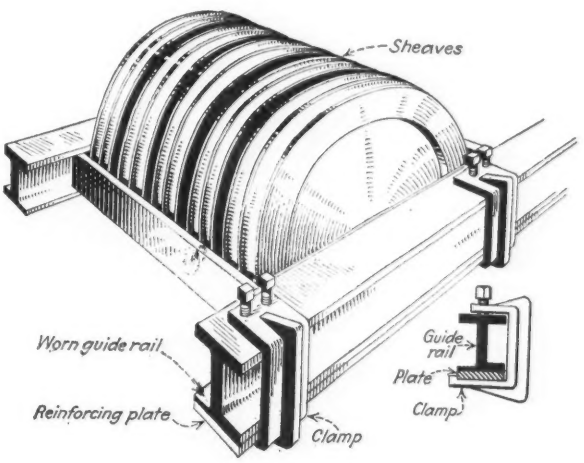
Checking the voltage at the generator terminals and across the busbars, in this case should have given an idea where the cause of the trouble was located. The high drop through the poor connection would cause the voltage to be considerably lower at the busbars than at the generator terminals.

This trouble also emphasizes the necessity of regular inspection of all parts of the equipment. Poor connections are generally easily detected by their high temperature and by discoloring of the metal, therefore can be easily located and repaired before they get in a condition to cause trouble. In plants where an adequate system of inspection and maintenance is followed, mysterious troubles are generally an unknown quantity. The faults are found before they have a chance to become a mystery.

Cleveland, O. T. O. DUNN.

Hydraulic Elevator Guide Rails Reinforced with Steel Plates

WHEN several horizontal-type hydraulic elevator machines are installed in a bank they are generally very difficult to repair without taking two machines out of service in addition to the one being worked on. Consequently, repairs that require a long time to do are to be avoided whenever possible. In a building with four machines of this type, one of the guide rails for the travelling sheaves on No. 2 machine became so badly worn that it had to be repaired or replaced. These guide



rails are made of steel I-beams, and the travelling sheaves are carried on shoes resting on the lower flange of the beams, as in the figure.

To replace the guide rail would have required taking Nos. 1 and 3 machines out of service to do the work on No. 2, and the cost of replacing the rail would have been about $300. After study of the problem it was decided that the rail could be reinforced at less cost than replacing it. Also none of the elevator machines need be out of service to do the job, as the work could be done when they were shut down at night.

Short steel plates were obtained ½-in. thick, the width of the guide-rail flange and of a length that would fit between the guide-rail supports. A design was made for a heavy clamp to hold the plates to the bottom side of the rail. These clamps were made of cast steel and fitted with two tightening screws, as indicated in the figure. After the equipment was ready it was a simple

matter for two men to put the plates into place. One man held the sections of plate against the under side of rail while the other put the clamps in place, after which they were tightened. The job was done at a cost of about $50, has been in service about three years and the rails are now apparently as serviceable as when new.

R. K. ROGERS.

St. Louis, Mo.

Causes of Turbine Vibration

A TURBINE-GENERATOR developed vibration, the cause of which was finally traced to the spindle warping. High-pressure steam was found to leak from the dummies through four holes around the spindle, causing uneven heating of the spindle and producing sufficient distortion to cause vibration. The holes were plugged; this stopped the vibration.

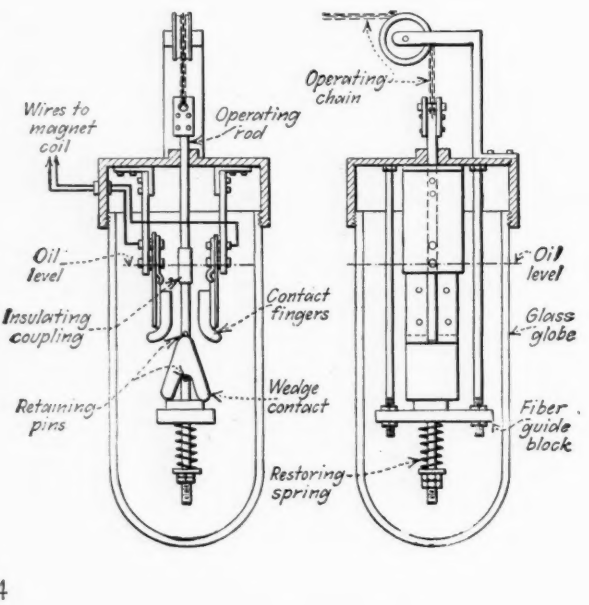
In another instance the cause of vibration was traced to wear of the coupling gear teeth. In this case vibration occurred only when the gears were in mesh. Installing a new set of gears cured this vibration cause.

Herts, England. W. E. WARNER.

Vapor-Proof Lamp Fitting Converted Into an Oil Switch

IT BECAME necessary to remove the meter for repair on the boiler feed-water line in our plant. So that a check might be kept on the amount of water going to the boilers it was decided to install an electrically operated counter on the boiler-feed pump. This counter would record the strokes made by the pump, thus providing a means of obtaining the approximate quantity of water used.

A revolution counter was fitted with a magnetic action for the recording device and placed in the engineer's office. For the contact-making switch an automobile stop-light switch was mounted on the steam end of the pump. This switch was connected between the cylinders by a chain to one of the connecting rods. The movement of the rod closed the switch once each stroke, which was recorded on the counter.



It was found that the stop-light switch had a short life in this service. To remedy this defect an oil switch was constructed using a vapor-proof light fitting as the base and oil container for the switch. The lamp socket was removed and the switch contact installed in its place, as shown in the diagram. A $\frac{1}{4}$-in. operating rod runs up through the center of the fixture and is insulated from the lower part by a fiber coupling. A wedge-type contact is used, taken from our stock of compensator parts.

The switch is installed in a vertical position at the end of the pump, the operating chain running up over a pulley. On each stroke of the pump the chain pulls up the operating rod, to which the V segment is fitted, and closes the circuit. As the connecting rod of the pump moves in the opposite direction the chain slackens and the restoring spring opens the contact. The glass globe is utilized as a container for the insulating oil, which is at a level well above the contacts. The switch is in operation 24 hr. per day, seven days a week and is giving satisfactory service.

ELLIS MILLS.

Toronto, Ont.

Synchronous Motor Trips Running Switch When Starting

THE magnetic field of a synchronous motor requires time to build up. Proof of this resulted from an investigation of a report that the running oil switch of a compensator-started synchronous motor would open on overload when the change-over from starting to running voltage was made. This motor operated on a three-phase, 2,200-volt, 25-cycle bus and was direct-connected to a 500-kw., 250-volt, direct-current generator. This generator, in addition to supplying a power load, excited the motor's field coils. The motor was started as an induction motor by closing a switch to connect power to a compensator, the reduced-voltage taps on the latter being connected to the motor by a second oil switch. After the motor had reached nearly full speed, the generator's voltage was built up to 180, the motor-field rheostat adjusted so that about three-quarters resistance was in circuit, and then field was applied to the motor by closing its field switch. Immediately afterward the reduced-voltage switches were opened and full voltage applied to the motor by closing the running oil switch. The running oil switch would then be tripped out by the instantaneous overcurrent relays.

To trip out the running oil switch required a high current, as the relays were adjusted to operate at about three times full load value. To find the cause of the high current several changes were made in the starting sequence, but without success.

It was then concluded that the high current was caused by a low power factor and resulted from a weak field. The reason assumed for this condition was that the field was allowed to build up to only part of full strength when full voltage was applied to the motor. To remedy this the motor was started on reduced voltage as usual, but after it had reached nearly full speed a higher voltage was applied to its field coils and the field allowed to build up for about 20 sec. before changing from reduced-voltage to full-voltage operation. This method of starting was successful, and no further trouble was experienced when starting the motor.

Hammond, Ind. S. EIN.

Welding Makes Possible Quick Replacement of Piping

FIG. 1 shows the piping arrangement between the house-service and fire pumps in an old office building. One morning about 5 o'clock the valve on the fire pump cracked and put the water service temporarily out of business. As there were no check valves in the lines

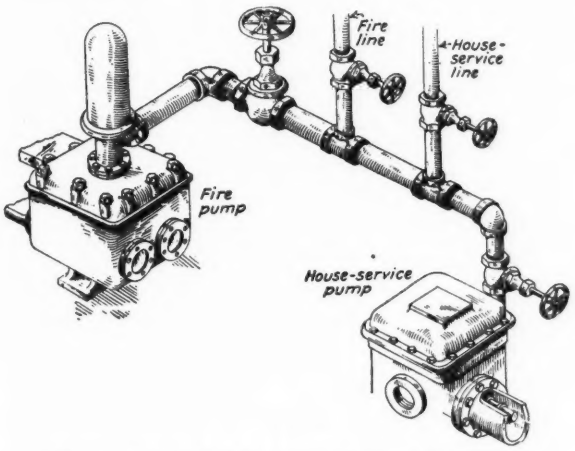


Fig. 1—Original pipe connections to the pumps

the pump room was flooded until the valves in the house-service and fire lines were closed. It is evident from the piping arrangement that failure of one valve put the entire water system out of business.

It was necessary to restore the service as soon as possible. This was done by breaking the defective valve off the line and capping the header. The house pump could then be put into service, but left the building water supply depending on one pump, a condition that had to be remedied as quickly as possible. Furthermore, because of the fire and insurance requirements it was necessary to keep water in the fire stand pipe at all times. If screw connections were again used between the riser

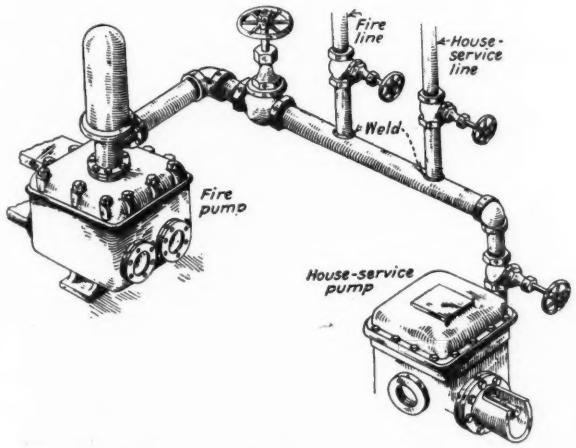


Fig. 2—Connections as they were made in the new pipe

and the header they would have required draining the risers and this it was desired to avoid if at all possible.

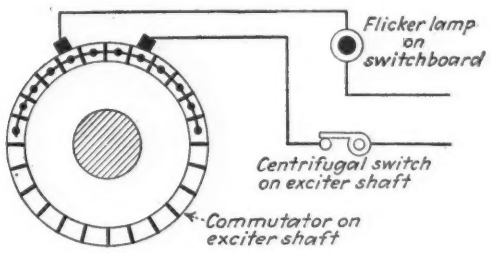
A complete new header was fabricated to go from the flange on the fire-pump air chamber to the service-pump discharge. This section was made up complete with new valves ready to be put in place. Two pieces of pipe were also cut to reach from the valves in the vertical risers to the pump header. This work was completed during the day and was ready to go in place as soon as the pump could be shut down at night.

To install the new pipe, the valves in the riser were closed and the T connections to the header broken. This allowed removing the old header by disconnecting at the service pump. The sections of the risers below the valves were unscrewed from them and replaced with new ones and the header put into place. After this was done the riser ends were welded to the header, preparations having previously been made for doing this when the pipe was fabricated. Fig. 2 shows the new pipe in place. Only two hours was required to do the job from closing the valves in the risers until everything was ready to start the pumps again.

New York City. R. C. POWELL.

Control of Generator Brakes Installed at Switchboard

IN SOME modern hydro-electric power stations, effort has been made to reduce operating expenses by placing the essential controls for the units at the generator switchboard. At the Saluda plant of the Lexington Water-Power Company, near Columbia, S. C., this has been



done, and it is possible for one man at the switchboard to operate the entire plant.

Among the many unusual operations controlled from the switchboard, that of applying the brakes and showing the operator that the machine is stopped is one of interest. The generator manufacturer recommended that, when stopping these heavy machines, which are rated 40,625 kva. at 138.5 r.p.m., the brakes be applied for a few seconds, released for about the same period and this intermittent operation continued until the machine came to rest.

Remote control of this operation required a solenoid-operated valve to control the air pressure on the brakes, and a pushbutton on the switchboard to operate the solenoid. To allow the operator to know how fast the generator is slowing down, a flicker device was installed which flashes a light on the switchboard. The changing speed of light flicker enables the operator to judge the speed of the machine and to see when it comes to rest. As shown in the diagram, this device consists of a commutator and brushes on the pilot exciter shaft. The commutator has one-half the bars short-circuited so that the light flashes once per revolution.

The circuit through the commutator also includes a centrifugally operated switch mounted on the shaft. This switch opens the circuit when the unit runs at synchronous speed and closes when the speed drops below that value. Thus the light remains out during normal operation and flashes only when the unit is slowing down or starting up.

O. L. HOOPER,
Reading, Pa. *W. S. Barstow & Co., Inc.*

CURRENT COMMENT

Boiler Gage Glass Readings Are Misleading

In the April 26th number, Mr. E. H. Krieg advanced additional reasons why the level indication in the gage glass may not truly represent the conditions at critical points in the steam boiler drum, because of irregular surface contours and especially at higher pressures and outputs when the disengaging surface becomes less pronounced. My proposal is to install one or more level indicating devices at locations determined by the engineer and to effect regulation at the most advantageous point.

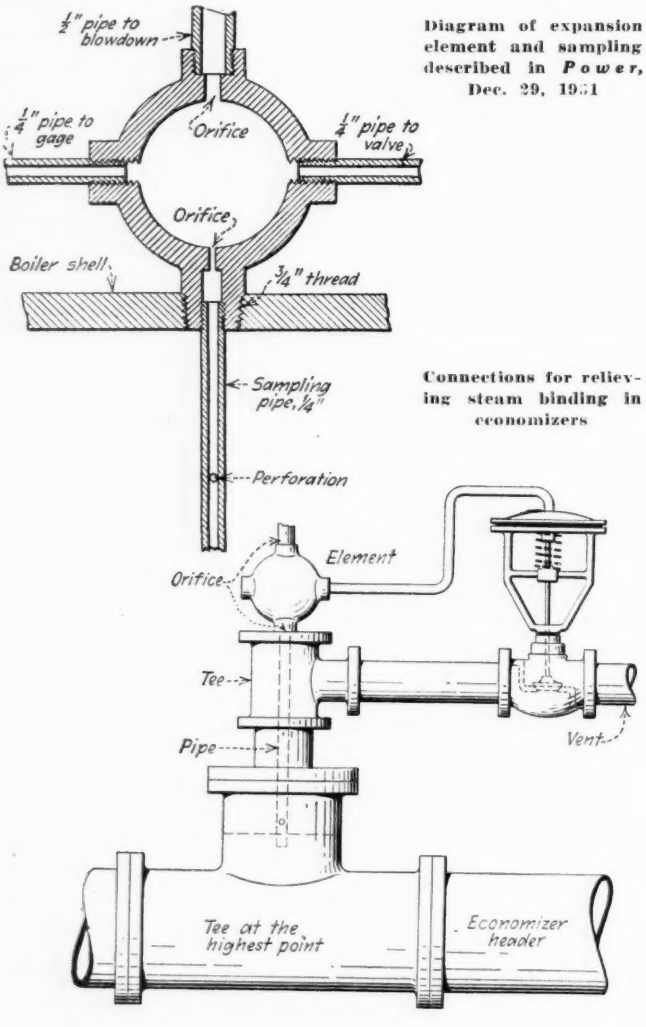


Diagram of expansion element and sampling described in *Power*, Dec. 29, 1931

Connections for relieving steam binding in economizers

The device consists of a vertical perforated sampling pipe extending into the boiler and leading to an external element fitted generally with two calibrated orifices in tandem and discharging to atmosphere. A pressure gage, which is also a level indicator is connected to the element.

The physics and method employed in the use of the elements, based on Napier's formula, are as follows: If the water level is below the end of the sampling pipe and only dry steam passes through the tandem orifices the resulting element pressure will be equal to the absolute boiler pressure divided by the ratio of the area of the secondary orifice to the area of the primary orifice. As the water level rises on the sampling pipe the negligible discharge of steam entrains a progressively increasing percentage of moisture until a water level is reached at which only boiling water passes to the primary orifice when the absolute element pressure, determined by test, will be about 2.5 times the pressure induced by the flow of dry steam. The sensible heat in the water causes flashing in the element, increases the specific volume and the pressure of the contained fluid mixture, the curve of pressure plotted against level being practically a straight line.

The customary method of determining the ratio of areas of the orifices is to divide the absolute boiler pressure by 30 and the resulting absolute element pressures will be 30 lb. with dry steam and 75 lb. with boiling water flowing. When this combination of sampling pipe and orifice system is used for level control in steam pressure vessels the element pressure regulates the control valve or the auxiliary unit to admit or to withdraw either water or steam as may be necessary to maintain a satisfactory water level. In the case of a steam bound economizer the element and the sampling pipe are placed at the point where steam will collect, as shown, and the control valve is set to close with rising water level or to open with low water and discharge the steam as it is generated.

The element pressure, which results from direct contact between boiling water and the sampling pipe inside of the boiler, is not affected by conditions outside of the boiler.

It is entirely possible that the water column or similar connection may not be the most desirable point from which to control the water level in any type of steam pressure vessel.

GRANT CAMPBELL.

Short Hills, New Jersey.

Blowing Soot from Regenerative Air Heaters

ON page 451 of the March 22 number of *Power* appears a partial digest of the latest N.E.L.A. Prime Movers Committee Report, containing the following comment on the cleaning of air preheaters: "Regenerative heaters have been so seriously plugged that one company reports the preheater element was dismantled in order to clean the gas passages. Soot blowers are also in general use to clean preheaters. Experience with these installations discloses that the steam pressure must frequently be raised at the soot-blower element above that normally anticipated effectively to remove deposits. Soot blowers, unless properly installed, may contribute to fouling and

corrosion rather than keep the preheater free of deposits."

This naturally infers that the regenerative preheater, which is the Ljungstrom, is the most difficult to keep clean, that its elements must be removed for cleaning, and that soot-blower troubles are to be expected. In order to correct such a wrong impression, here is the exact statement from the report: "The elements of the regenerative preheaters of the 1927 installation have fouled. The gas passages became so restricted that it was necessary to remove the elements to clean effectively the heating surface. The soot-blower nozzle was redesigned and the steam pressure on the soot blowers was increased from 75 to 150 lb. per sq.in. gage, which eliminated the trouble."

The N.E.L.A. statement is true, but does not explain that 125 lb. to 150 lb. steam pressure was originally specified for blowing the heating elements, and that the change to the soot blower consisted merely in substituting a plate with larger orifice in its supply line.

The initial installation developed no cleaning troubles over a long period, and when deposit did build up, investigation proved that the soot blower was getting only 75 lb. pressure. Removal, cleaning and replacement of the heating elements and correction of the steam pressure stopped the trouble. None further developed during the year and a half following, and no more is anticipated. The difficulties were due solely to easily remedied exterior conditions not attributable to Ljungstrom preheater design.

With these facts in mind, the N.E.L.A. report throughout is distinctly favorable to the regenerative preheater, or at least should not be construed to indicate that clogging, cleaning and soot-blower troubles are to be expected. Further, the significance of the fact that under exceptional conditions the heating surface of a regenerative air preheater may have been removed for thorough cleaning of the gas passages should not be misinterpreted. The possibilities of easy heating surface removal, cleaning and replacement are a unique advantage, and the above incident, as reported by Saginaw River steam station, has not changed the high regard of the station operators for this equipment.

New York City. H. S. Colly,
President, The Air Preheater Corp.

Superheated Steam in Laundry

I was very much interested in the article by H. M. Friend on laundry superheaters, in the August number of *Power*. Undoubtedly a good deal of time and thought has been spent on the layout, and the investment should yield a nice return. I think, however, that a much bigger saving in operating time and fuel could be made.

Mr. Friend refers to the sudden demand on the boilers causing the pressure to vary between 70 and 110 lb. The biggest cause of this variation is the intermittent flow of make-up water to the water heater, which is most likely of the pressure type. Much of this pressure variation could be avoided by installing another type of heater where the surge inflow of water to the wash wheels is entirely divorced from the flow of cold make-up water to the heater. Or, to avoid going to this expense, an elevated hot-water storage tank could be installed so that the discharge valve at the softener could be throttled to give a uniform flow to the present water heater on its way to the hot-water storage tank. Fluctuations in water level in this tank would serve the wash wheels as required.

The pressure variation could also be reduced by installing a heat reclaimer to pick up heat from the soiled waste water, and place it in the fresh water before it goes to the water heater. This would reduce the boiler load 25 per cent nicely.

A non-venting type of boiler return system could be installed to replace the present trap system and hot well. Most likely the 338-deg. condensate (corresponding to 100 lb. boiler pressure) is now dropped 212 deg. or lower with the resultant loss by flash steam before returning this condensate to the boiler. Ironing could also be speeded up 20 per cent by this change.

Mr. Friend's idea of superheated steam on flat work ironers is fundamentally wrong. Satisfactory ironing conditions are secured from the latent heat in the steam, and no superheated steam can give us its latent heat until it has lost its superheat. Moreover, the unit heat transfer with superheated steam in the shell is much less than with saturated or moist steam in the same shell.

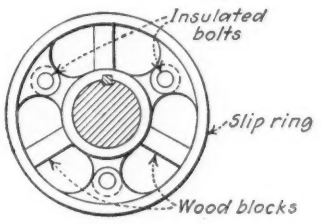
He is correct in saying that the engine consumes less superheated steam because it reduces the initial condensation in the cylinder.

Kansas City, Mo. N. W. Petefish.

Three Little Wood Blocks Keep Generator in Service

Resourcefulness is one mark of a good maintenance man. Some are in simple little stunts, others take the form of more difficult accomplishments. Whatever the form, it is usually the thing necessary to save the situation.

The repair shown in the diagram is an example of this. In this case three little pieces of wood made it possible to get a badly needed generator into service in a few minutes, where otherwise it might have taken days. This plant was as badly neglected as possible, and furthermore no provisions were made for making repairs, even though the plant was located in a very isolated district over 100 miles from a railroad.



One day when a generator was being started, it was found that one of its slip rings had come out of place. Examination showed that the screws that held the ring to its hub were destroyed and others were not available. When the operator was about to give up hope of repairing the machine a stranger came into the plant. Being apprised of what had happened, he requested an opportunity to fasten the ring in place. With a pocket knife he cut three pieces of wood of proper length to wedge tightly between the ring and hub as shown in the figure.

The job was so well done that the machine worked that way for several days until new bolts and insulating material could be obtained. This little stunt is so simple it is hardly worth mentioning, but how many of us would have thought of it under the same circumstances?

Chicago, Ill. B. A. Briggs.

READERS' PROBLEMS

TREATMENT FOR HIGH-SULPHATE WATER—*The following is an analysis of our water for boiler use:*

pH	*7.0*	
P or Causticity Content	*0*	*gr. per gal*
M or Alkalinity Content	*2*	*gr. per gal*
Free carbon dioxide	*0*	*gr. per gal.*
Chloride content	*2*	*gr. per gal.*
Hardness	*3*	*gr. per gal.*
Sulphate content	*55*	*gr. per gal.*

Will you please give us your opinion of it? It is used in a horizontal tubular boiler of 15 lb. pressure for heating purposes only. U. S. C.

[The following answer to this question was submitted by W. J. Ryan of the Water Service Laboratories, 247 East 56th St., New York City—Ed.]

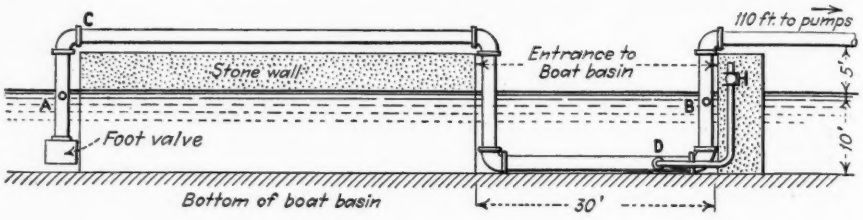
"The analysis as stated shows that the water may be used in the heating boiler, but the high content of sulphate, and the presence of 3 grains per gallon of hardness, indicate that a hard adherent sulphate scale will probably be formed on the heating surface, unless some means is used to prevent it.

"The use of soda ash or tri-sodium phosphate will cause the formation of a sludge which may be removed by periodic blow-off; or a soft deposit which may easily be removed when the boiler is cleaned at the end of the heating season.

"The amount of soda ash required would be approximately three-quarters of a pound per thousand gallons of make-up. The amount of tri-sodium phosphate required would be approximately one and one-quarter pounds per thousand gallons of make-up.

"In order to get the desired results it is advisable to make periodic analyses of both the raw make-up water and of the boiler water so that the treatment may be checked and the chemical dosage regulated."

HOW TO DRAIN A LOOP IN A PIPE LINE—*Seawater is to be supplied to our laboratory by a centrifugal pump through 4-in. suction and discharge pipes. The suction line is arranged as in the figure and is about 300 ft. long. Since this line will be in operation during the summer months only, we are faced with the problem of draining the loop across the entrance to the boat basin, for if water is left in the loop it will be subjected to freezing temperatures. What is the best way of draining the loop?* C. B. S.



There are several ways of handling this problem. The simplest would be to tap a nipple in the pipe at *A* and *B* in the figure. These nipples should be about 18 in. below low-water level and a valve should be installed on each. When the pump is in service the valves are closed. During the winter months the valves are open and the water in the vertical sections of the pipe will remain at outside water level. Unless the climate is very severe there should not be any danger of ice forming inside the pipe and bursting it.

If it is desirable to drain the line, a flange connection could be put into the line at *C* and the foot valve with its vertical section of pipe removed. After this has been done compressed air can be admitted at the pump and the water blown out of the line. The air will probably not remove all the water from the loop, but its level will be brought well below that where freezing might occur.

Another suggestion is to remove the foot valve as previously mentioned. When the loop is installed a small connection is brought from its lowest point to above the water level. The pipe may then be drained by a small hand pump connected to *D*. Local conditions will have an influence on what is the best way to do the job, but in any event it will probably be advisable to remove the foot valve, since if left in the water all winter it will not be in very good condition when the pump is again started.

Why Wound-Rotor Motor Operates at Reduced Speed

Answers to the August Question

The Question

WE HAVE a 150-hp., 1,150-r.p.m. 440-volt, wound-rotor induction motor driving a centrifugal pump. This motor has given trouble by running about 25 r.p.m. below its rated speed. A check on the speed of the generator shows that its frequency is correct. The motor is underloaded because the decrease in speed has caused a reduction in the pump's discharge. What are the possible causes of the motor's running below rated speed? M. L. K.

Cause of the Trouble May be in the Pump

CONSIDERING the pump, it is possible that rubbing of the impeller causes the motor's speed to decrease. A leak in the discharge pipe would also cause a decrease in speed because of the increased quantity of water pumped when the head is reduced.

Assuming that the motor is at fault, the reduction in speed may be due to worn bearing letting the rotor rub on the stator core, and would be evidenced by heating. Low voltage on the stator will increase the rotor's slip. This voltage should be within 10 per cent of the nameplate rating, and balanced on the three phases.

The trouble may be due to an increase in the rotor's resistance because of poorly soldered or otherwise defective connections, bad brush contact, or failure of the controller to short-circuit the brushes.

I would suggest that the rotor circuit, including the winding, be examined carefully for poor connections. Poor connections ordinarily run hot, therefore all accessible points, including the controller's contacts, should be felt immediately after the motor is stopped following an extended full-load run.

Oakland, Cal. RALPH BARR GLEN.

Change in Rotor Resistance Affects Motor's Speed

AS THE full-load speed of a 60-cycle 150-hp., 1,200-r.p.m. synchronous-speed wound-rotor motor may be anything from 1,100 to 1,175 r.p.m. at rated voltage and frequency, depending on the type and make, the actual full- and half-load speeds of M. L. K.'s motor might be verified by inquiry to the manufacturer. Assuming normal frequency, voltage below rated value at the motor's terminals, would reduce the speed a little when the motor is loaded. Therefore, verify voltage and current balance in the phases, as well as the frequency.

Very little extra resistance in the rotor circuits could easily cause more than 25 r.p.m. drop in speed. If there is a slip-ring short-circuiting device built into the motor it should be inspected, both as to action and contacts, so as to assure an effective short-circuit of the

rotor windings, when in the running position. If there is no such device on the motor, the slip-rings, brushes, all rotor winding and cable connections and the contacts on the starter should be inspected, loose connections tightened, contacts cleaned.

In either case, the voltage drop across the slip-rings should be measured after inspection to make sure that it is practically zero while the motor is running loaded.

New York City. A. F. OLIVER.

Reduction in Speed Should Not Seriously Affect the Pump

THE most likely causes of reduction in speed referred to are either low terminal voltage at the motor, or too much resistance in the rotor circuit. If the terminal voltage is found to be low, either the power supply as a whole, or the individual circuit supplying this motor can be checked and corrected.

If the trouble is in the rotor circuit, it may be due to poor contacts in the control device, badly pitted and blackened collector rings, or the connecting leads between the rings and the controller having too high a resistance. A very small increase in resistance in the rotor circuit would cause the speed reduction referred to.

One assumes this to be a new installation for fire protection service that has not been passed by the fire-insurance authorities because the motor is not up to speed. Since the reduction in speed is only a little over 2 per cent, the pump output would not be very seriously reduced, and it is probable that in an ordinary commercial installation no one would have noticed the difference.

Drummondville, Que. C. E. OLIVE.

Suggests Short-Circuit Switch in Rotor Circuit

THE wound-rotor induction motor may run slow for any of the following reasons:

1. The applied voltage may be low.
2. The load may be excessive.
3. There may be an open or high-resistance secondary circuit.
4. The bearings may be worn so that the rotor is rubbing on the stator core.
5. The rotor may not have sufficient end play to allow it to run in its magnetic center, and as a result a shaft collar is pulled against one of the bearings.
6. The windings may have been reconected with an improper connection, causing the effect of low voltage.

If the windings have not been worked on, the trouble is not due to cause No. 6, and the voltage should be checked. If the three-phase voltage is normal, then a switch should be connected to the rotor rings so that they may be short-circuited after the motor is running. Any high resistance in the external rotor circuit will then be cut out, and if the fault is due to that cause the motor speed will pick up.

VICTOR N. FRIEDMAN.
St. Louis, Mo.

A Question for Our Readers

OUR 350-hp., 225-r.p.m., 3-cyl., 4-cycle, solid-injection Diesel engine ran all right for two years while our load was heavier than at present. Now there is a bad knock, especially in the cylinder nearest the flywheel, and exhaust from that cylinder seems much hotter than from the others. We burn more fuel oil than when there was more load. We use metered city water for cooling and keep the water below 170 deg. F. as it leaves the engine, to avoid deposits from the hard water. Why doesn't the engine run as well as it did before? Why does it take more fuel? Should the pistons be taken out and cleaned as well as the exhaust valves? A. F. O.

Suitable answers from readers will be paid for if space is available for their publication.

Faulty Controller Caused Speed Reduction

ASSUMING that there is no mechanical trouble in the pump, that the motor is not overloaded as stated and that the stator phase currents are balanced, then I would say that the drop in speed is probably due to an increased resistance in the rotor or secondary circuit. Since for any fixed torque with constant voltage and frequency impressed on the stator windings the slip of an induction motor varies directly as the rotor resistance, it follows that the speed will drop due to this increased resistance.

The trouble might be due to poor brush contact on slip rings, loose pigtails, high resistance joint in the rotor winding, improper contact in controller, loose cable terminals, etc. I have experienced a trouble similar to this due to the handle of a drum-type controller slipping back nearly one notch from full-speed position due to faulty alignment of the pawl and ratchet wheel that was intended to keep the controller contacts in the proper position.

Onalaska, Wash. J. R. POORE.

Fluctuating Load Caused Change in Motor's Speed

THERE are various causes which would make the motor run below its rated speed, such as, wrong voltage and frequency, short circuit or open in the stator circuit, too small connection wires, resistance left in rotor circuit.

If for any reason there has been a change in the pump head, it would cause this trouble. For instance, if the head on the pump is decreased, there would be an increase in the pump discharge and an increase in the motor's load, causing it to run slow. In one instance, we had several motors operating from the same generator. One of these motors was driving a fluctuating load, which caused a change in speed of other motors on the system even though they were operating at a constant load.

Buffalo, N. Y. HAROLD J. AGATE.

Obstruction in Water Passages Causes Reduction in Discharge

THE speed of the motor has decreased only about 2 per cent. This small decrease in pump speed would not in my opinion materially affect the discharge volume. The reduction of discharge might be due to an obstruction in the discharge line, in the impeller or some of the pump's internal passages, or a leak or obstruction in the suction line.

Any of these causes would also tend to unload the motor. It may be that the impeller is rubbing on one side of the pump or the thrust bearing is not functioning properly. These conditions would cause internal friction and also leakage between the impeller and pump casing and result in a reduction of the pump's discharge.

It might be that worn bearings would produce enough magnetic side pull on the rotor to tend to slow down the motor. This condition would materially affect the starting torque.

GRADY H. EMERSON.
Birmingham, Ala.

Gives Five Groups of Causes for Slow Speed of Motor

REDUCED speed may be caused by any of the following faults:

1. An overloaded motor, due to: A, worn bearings in motor or pump, B, poor alignment of bearings, C, pump packing too tight.

2. Low voltage at the motor due to: A, too heavy load elsewhere on the same line, B, generator or transformer supply overloaded, C, faulty voltage regulator.

3. Rotor resistance not entirely cut out, because of an improperly functioning controller.

4. High-resistance contact in rotor circuit caused by: A, loose wires at the controller or collector rings, B, loose rotor bars or rings, C, poor contact at the brushes and collector rings, D, poor contact at the controller fingers and segments, E, partially open rotor coils.

5. Partially grounded rotor coils.

Lowell, Mass. CLARENCE W. HOPE.

THE ENGINEER'S BOOKSHELF

Motor Rewinding

REWINDING SMALL MOTORS. *By Daniel H. Braymer and A. C. Roe. Published by McGraw-Hill Book Company, 330 West 42nd St., New York City. 1932. Second edition. Cloth; size 6x9 in.; 230 illustrations; many tables; 263 pages. Price $2.50.*

The first edition of this book appeared in 1925 and treated in a comprehensive way the rewinding of various types of small motors in use at that time. Since then, capacitor-type motors for single-phase operation have come into extensive use. To provide information on winding these and other special types of motor the authors have deemed it advisable to include a 16-page appendix on special types of alternating-current motors. This appendix is the major change in the new edition. The presentation is from the practical man's viewpoint, and those interested in the repair of small motors will find this book a valuable source of information.

Steam Power Plants

STEAM POWER PLANT ENGINEERING. *By Louis Allen Harding. Published by John Wiley & Sons, 440 Fourth Ave., New York City. Cloth; 9x6½ in., 777 pages, illustrated, charts and tables. Price $10.00.*

This text, which replaces Volume II of "Mechanical Equipment of Buildings," by Harding and Willard, treats of the equipment required to convert the heat released by combustion into work or electrical energy through the medium of a vapor cycle. The author has assumed that the reader has some knowledge of thermodynamics and the properties of steam. Incidentally, the author unfortunately has used Goodenough steam tables throughout the text instead of the more recently compiled data on steam properties.

The book treats of the major problems in the design of most of the equipment in steam power plants, their co-relation in the plant and economic considerations involved in their selection. An unusually large amount of data concerning the efficiencies and characteristics of the various apparatus are included in charts and tables which makes the text of value to practicing engineers as well as to students.

Apparatus discussed in the book are steam generation and combustion equipment, feedwater heaters and treatment, condensers and cooling towers, piping, valves and fittings, power plant cycles and plant arrangements. These subjects have been arranged in logical order in thirteen chapters. For a book of this type the chapters on pumps, feed water treatment and steam turbines are unusually complete.

In preparing the text the author has drawn freely from articles in the technical press and engineering society papers.

Materials Handling

MODERN MATERIALS HANDLING. *By Simeon J. Koshkin, Asst. Prof. Machine Design, Cornell University, Published by John Wiley & Sons, Inc., New York City. 1932. Cloth; size 6x9 in.; 174 illustrations, 488 pages. Price $6.00.*

In this book the author has treated of and analyzed modern methods of handling materials. These include those generally found in manufacturing and construction processes and coal- and ash-handling around power plants. The book is based on a lecture course given during the past six years at Cornell University, and deals with those factors involved in selecting equipment to do the handling job most economically.

Among the chapters are five devoted to cranes, three to overhead transportation, three to industrial trucks, nine to different types of conveyors, two to skip hoists and bucket elevators and two to coal and ash handling. Some phases of material handling have been omitted, particularly among the heavier classes of machinery, such as coal towers, car dumpers, mine hoists and machinery as used on coal and ore docks.

Notwithstanding these omissions the book contains a wealth of condensed information on material-handling problems presented in practical form. The work has been prepared primarily as a text book, but should find a wide clientele among engineers and others interested in material-handling problems.

Fluid Meters

FLUID METERS, PARTS I AND II. *Report of A.S.M.E. Special Research Committee on Fluid Meters. Published by the American Society of Mechanical Engineers, 33 West 39th St., New York City. 1931. Paper; size 8x10½ in.; 118 illustrations; 153 Pages. Price, Part I $2.00; Part II $1.75.*

After eight years of work, the special research committee on fluid meters of the American Society of Mechanical Engineers presented the first edition of its report on fluid meters in 1924. The demands for this report were such that a second edition was printed in 1927 and a third edition in 1931. This report is in two parts. Part I deals with the theory and applications, and Part II describes how the various types of fluid meters operate.

In Part I the chapter headings are: Classification of fluid meters; weighing meters; volumeters; current or kinematic meters; head or dynamic meters; area or geometric meters; head-area meters; force meters; thermal meters. There are also four appendices: Nomenclature; summary of important formulas, theory of head meters, and a bibliography on meter literature.

In Part II, the construction and operation of head meters, area meters, head-area meters and thermal meters as manufactured by nineteen companies are described. Quantity meters will be discussed in a later edition. Proper methods of installation and care of meters will form Part II, which is now being prepared. These reports represent the crystallization of the best thought on the subject and contain a wealth of information for everyone interested in fluid measurements.

BRIEF REVIEWS

COAL AND COKE. Report of A.S.T.M. Committee D-5. Available from American Society for Testing Materials, 1315 Spruce St., Philadelphia, Pa.—Includes proposed tentative method of sampling coke for analysis and tentative method of sampling coal by the ball-mill method.

WINDKRAFTWERKE (WIND POWER PLANTS). By Herman Honnef. Published by Friedr. Vieweg & Sohn A.G., Braunshweig, Germany. 111 pages, 6x9 in. 28 illustrations, 22 tables. Paper covers. Indexed. Printed in German. Price RM 4.8—Wind power plants are arousing much interest in Germany in economic, scientific and technical circles, as indicated by the foundation of the Society for Wind Power Research (Gründung der Deutschen Windkraft-Studiengesellschaft). Here are summarized various methods of wind power production, together with estimated costs and capacities.

CLASSIFICATION OF COALS. Report of A.S.T.M. Sectional Committee. Available from the American Society for Testing Materials, 1315 Spruce St., Philadelphia, Pa.—Gives digest of subcommittee activities and a good bibliography on coal classification.

ÜBER KORROSIONSERSCHEINUNGEN IN HOCHLEISTUNGS DAMPFKESSELN (ON CORROSION PHENOMENA IN HIGH-PRESSURE STEAM BOILERS). By Von E. Lupberger, Berlin, Germany. Available from the Verein der Grosskesselbesitzer, Berlin, W62, Maabenstrasse 9, Germany.—Summarizing and discussing data on corrosion from leading German technical societies and including a bibliography.

Operating Data in

N.E.L.A. REPORT SHOWS DECREASE IN TURBINE OUTAGE

THE turbine report for 1931 of the Prime Movers Committee of the National Electric Light Association presents operating records of 334 turbines of 20,000-kw. and larger capacity, and of 12 turbines of small capacity with operating pressures of over 1,000 lb. per sq.in. These records reflect the present business condition, in that decreases in power demand led to the presence of more excess capacity in central stations than in former years. Hydro-electric power was utilized to the fullest possible extent. Both of these factors tend to lessen the use of steam generating equipment and to lower the unit operation factor, which decreased from 62.96 per cent in 1930 to 57.93 per cent in 1931.

The lower demands of 1931 and the available reserve capacity apparently have led to more conservative loading and to better operation of units in use, for the total outage hours factor has decreased to 8.37 per cent, the lowest so far recorded during the years that the N.E.L.A. has been collecting operating data. The individual outage hour factors for turbines, generators and condensers have also decreased. A part of these decreases can probably be attributed to the tendency of member companies to defer outage for annual inspection as an economical measure. Outages due to outside causes showed a considerable increase over 1930 figures.

Out of the 249 turbines upon which data is presented on the frequency of annual inspection, 68 were inspected in 1930 only, 104 were inspected in 1931 only, and 77 were inspected in both 1930 and 1931. The average outage period for turbine inspection increased slightly from 370 hr. per turbine in 1930 to 381 hr. per turbine in 1931.

The outage factor due to buckets and blades shows an increase of 55 per cent from 8.72 per cent in 1930 to 13.51 per cent in 1931. A portion of this appears to be due to blade erosion, which is given special attention in the report, a summary of which will be given later.

The data on the twelve high-pressure turbines indicate an increase of the unit capacity factor from 51.28 per cent in 1930, to 55.58 per cent in 1931. The service demand availability factor also increased from 82.68 per cent in 1930 to 88.78 per cent in 1931. These results indicate improvement in the reliability and availability of these machines.

Statements were obtained from a number of companies concerning the effect of age on efficiency of turbines. Some of the data presented show turbine test curves for the years 1925 to 1931 inclusive and indicate an increase in heat consumption of 1.5 per cent from 1926 to 1929. Curves of water rate are also shown to indicate the improvement resulting from turbine overhaul. These show that the steam rate was improved 3 to 6 per cent by overhauling turbines in the Horseshoe Lake Station.

Blade Erosion

Blade erosion prevails in all makes of turbines, though it appears to be more serious in those low-pressure stages in which top speeds exceed 950 ft. per sec., and in which the moisture content is high. Erosion is much less troublesome on blading with tip speeds of 900 ft. per sec., or where the steam has been reheated as on some high-pressure units. Reports were received from 32 companies, covering about 100 cases of blade erosion.

The life of blading where erosion has necessitated replacement varies from three to eight years, with an average life of about 5½ yr.

The moisture content at the last blade row appears to range from 10 to 14 per cent. Many turbines are being provided with drainage grooves in the last stages, and also with leak-off holes from the last stages to the condenser, but there is no definite data available on the effectiveness of such devices as moisture eliminators.

The eroded blading has generally been manganese bronze or nickel steel. The new blading materials are usually of stainless steel, Ascoloy, or chrome iron, the useful lives of which have not as yet been determined.

A study of the data indicated that erosion appears to be dependent upon hours of operation, but did not seem to be directly related with load during those hours.

Erosion has generally been confined to the outer half of the blade, and more particularly to a section 1 to 1½ in. from the end of the blade. However, many companies have reported erosion of the front surface of the blade, particularly in the neighborhood of lacing wires.

Ends of unshrouded reaction blading erode badly, thereby increasing the curve between cylinder and casing, and decreasing the efficiency of the unit. In some cases this decrease in efficiency was stated to be 1 to 1½ per cent.

Conditions of Turbine Exhaust

The report contains a long statement by A. G. Christie and R. Colburn, in which is presented a method for finding the leaving losses of a steam turbine, and for interpreting the values thus found. It also includes methods for determination of the maximum moisture content of the steam at the last row of blades, and a study of blade erosion, its causes, its occurrence under light loads and certain proposed remedies.

Statements from various utility companies are included concerning erosion of water glands, controls to eliminate atmospheric exhaust valves in pipes, misalignment of turbine and generator shaft through the settlement of foundation, evaporator and bleeder heater data and operation as a synchronous condenser. The report contains only one test of a turbo-generator unit.

Manufacturers' statements, as usual, give information concerning the units which the respective companies installed during the year, and new developments in turbine design.

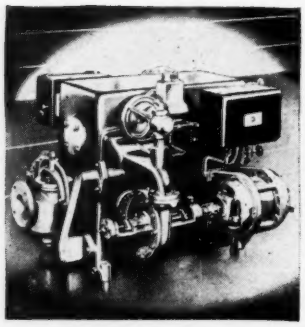
DIESEL ENGINES IN THE COTTON OIL INDUSTRY

In a paper under the above title before the convention of the Cotton Seed Oil Superintendents in Memphis recently, R. L. Loggins, superintendent of the Blytheville (Ark.) Cotton Oil Mill, said that most economical power for this type of plant was provided by the isolated plant using diesel engines. He explained that even though the mill operates but for a short period each year, it runs 24 hours a day during the season, thus approximating the total yearly operating time for many diesel plants in other industries.

A number of price comparisons were provided by Mr. Loggins, showing decided savings in favor of the diesel in the cotton oil industry. One mill for example, estimates an annual saving of $15,000 through installation of a 360-hp. diesel which lowered cost of seed crushed from $2 to thirty cents per ton. He further estimates that unless power can be provided by other means or purchased for less than a cent per kw.-hr., it cannot compete with the diesel successfully.

His mill installed a 660-hp. De La Vergne engine three years ago. After a 100-hr. run, tests were begun which continued over 17 days. These showed fuel oil consumption of 6.34 gal. and 0.0218 gal. of lubricating oil per ton of seed crushed. Total power cost per ton, without fixed charges, is $0.346, as compared with the previous $1.05 for a steam engine. This gives a saving of about $0.70 per ton, or a monthly saving of $2,192 on the 3,132 tons of seed crushed. No operating troubles have been experienced under this service, and present low cost of fuel and lubricating oils have cut power cost to half of what it was when the tests were run.

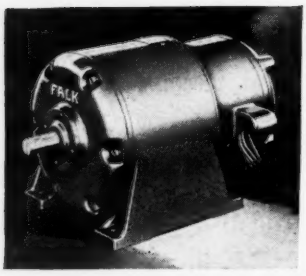
WHAT'S NEW IN PLANT EQUIPMENT



Vacuum Pumps

Hoffman - Economy vacuum pumps and condensation pumps are simplified and improved in appearance. Now employ rectangular receivers of cast iron, more sturdy and non-corrosive. Motors of standard make to permit quick replacement. All pump parts readily accessible.

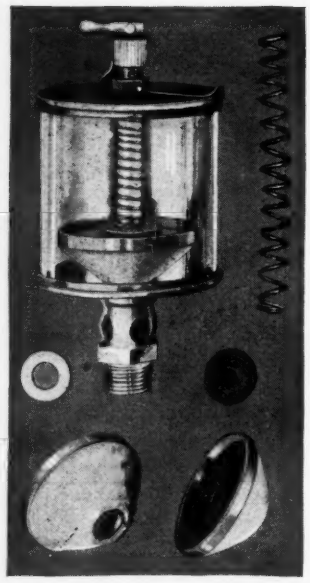
Economy Pumping Machinery Co., 3431 W. 48th Place, Chicago, Ill.



Motor-Reducer

"MotoReduceR" combination horizontal motor and speed reducer unit solid, compact. Designed to avoid misalignment of parts and avoid vibration and noise. Motor and gear apparatus contained in single housing. Gears heat-treated nickel steel with helical cut teeth and running in oil bath. Bearings antifriction type with slow-speed shaft and Timken roller bearings. Available in single, double and triple types with ratios up to 450 to 1, and with standard open type or totally inclosed fan-cooled motors, polyphase and single-phase. Also available with d.c. motors up to 10 hp.

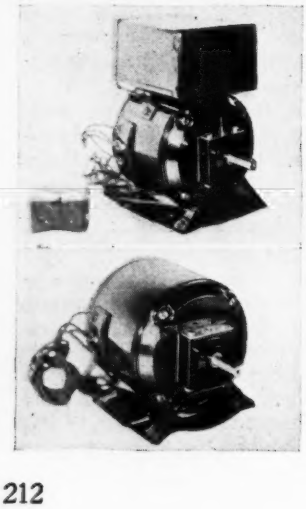
Philadelphia Gear Works, Inc., Erie Ave. at G St., Philadelphia, Pa.



Oil Cup Filter

A specially impregnated felt is the filtering medium in this filter. Oil passes upward to the inside of the cone, thence out through the exit hole in the cup's central tube to the bearing. Thus, the filter membrane works in a semi-inverted position, and is so protected from all direct pollution by the coarser and heavier settlings from the oil. Sizes for practically all standard oil cups.

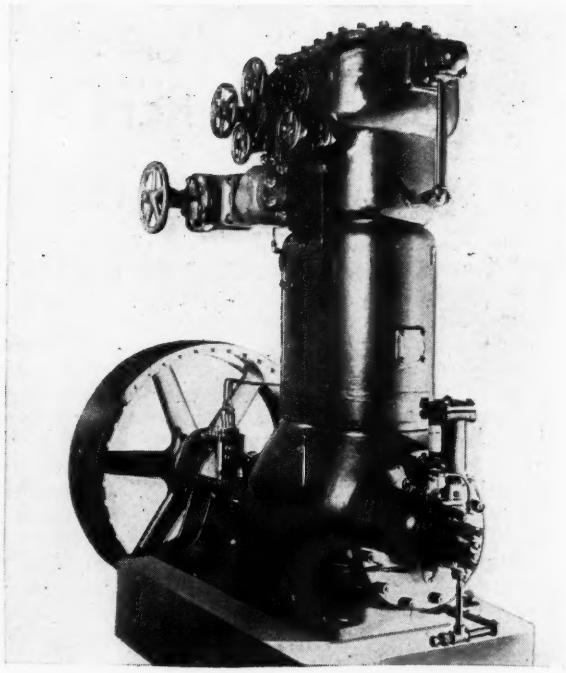
H. B. Morrow Co., Mishawaka, Ind.



Fractional Horsepower Motors

Frames, shafts, bearings and mounting arrangements in this line of fractional horsepower motors interchangeable, rating for rating. Five frame sizes serve the entire line, ranging in output from 1/30 to ¾ hp. Split-phase (bottom), capacitor (top), repulsion-induction, polyphase, direct-current and repulsion motors included. A feature is improved type resilient spring mounting.

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.



Scale Retarder

Nalco No. 8 is anti-incrustant or scale retarder for use in feed-lines, heaters, pumps, injectors, regulators, diesel and oil engines, surface condensers, heat exchangers, cooling water, but not for boiler scale prevention. Complete information in Bulletin No. 28.

National Aluminate Corp., 6216 West 66th Place, Clearing Station, Chicago, Ill.

Oxygen Absorber

"SeizO$_2$," a stable alkaline solution unaffected by light, claimed to absorb 47 times its volume of oxygen, or four times the capacity of pyrogallic acid solution. Used for gas analysis.

Hays Corporation, Michigan City, Ind.

Water Clarification Method

Nalco No. 41 is sodium aluminate in special form for use in small amounts in the clarification of water through pressure filters, for ice plants, and in oil removal filters, is compressed into ball form for use in feeder similar to an alum pot. Feeder is placed on water line or around pump and a small amount of water by-passed over the sodium aluminate ball. By regulating amount of water by-passed, rate of solution is controlled. Complete information in company Bulletin No. 29.

National Aluminate Corp., 6216 West 66th Place, Clearing Station, Chicago, Ill.

Ammonia Booster Compressor

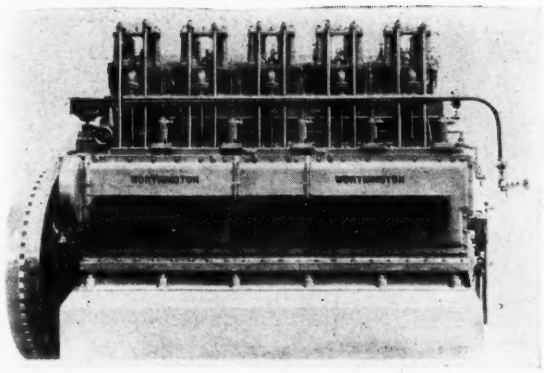
Semi-inclosed, vertical and single-acting booster compressors designed for use in plants where special low temperatures are required. Will reach —20 to —50 deg. F. Used to boost or raise the pressure of a gas from a low-temperature evaporator to the pressure level of another evaporating system handling a higher temperature load and connected to an independently controlled compressor. Can be furnished in either simplex or duplex drive styles arranged for mounting motor direct on a compressor shaft, or with a V-belt adjustable-center drive.

York Ice Machinery Corp., York, Pa.

Fin-Type Heat Transfer Elements

For heating or cooling gases of low heat conductivity or liquids of high viscosity, this heat transfer surface uses longitudinal fins on the outside of the heating elements, thus increasing the exterior heat transmitting surface 4 to 6½ times. Patented, known as "G-R G-Fin heat transfer element." Has fins spaced about the circumference of ¾-in. steel pipe and fastened mechanically. Elements may be furnished as separate units or assembled in a suitable shell to form a complete shell-and-tube heat exchanger. No cross baffles necessary.

The Griscom-Russell Co., 285 Madison Ave., New York, N. Y.



Four-Cycle Direct-Injection Diesel Engines

Covering power requirements from 50 to 1,000 hp. in two to eight-cylinder units, this improved line of four-cycle direct-injection moderate speed diesels has these features: Individual fuel pumps for each cylinder, fuel lines of equal length, hydraulic control of fuel injection; individual air starting pilot valves control admission of starting air to each cylinder; spray valves pressure-actuated, without push rods or levers. In larger engines, air inlet or exhaust valves are carried in removable, interchangeable cages. In the smaller, valves seat in cylinder head and operate in removable bushings. Can be converted to operation on manufactured or natural gas.

Worthington Pump & Machinery Corp., Worthington Ave. at Warren St., Harrison, N. J.

Gas Engine

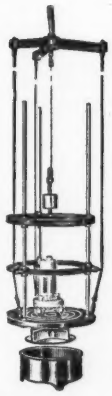
This vertical two-cycle gas engine running on artificial or natural gas claims fuel consumption as good as of the old type four-cycle engine. Has 2 to 12 cylinders in one row, as on diesel engines, and is available single-acting for small output, or double-acting for large output. Can be built in units of 12 cylinders, developing outputs as high as 7,500 kw. Output engine shown 400 hp. per cylinder at 300 r.p.m. American agent, F. J. Joerger, 40 Rector St., New York City.

M A N Co., Maschinenfabrik Augsburg, Nurnberg, A.G., Germany.

Pipe Threaders

"Toledo" 1- to 2-in. "Super" pipe threaders in two models, No. 1B plain and No. 1BR ratchet. Both similar to No. 1 and 1A units except for new diehead and pipe holder. Three-jaw pipe holder obviates bushings. Thumbscrews have large wing heads for convenience. Will thread brass, copper, as well as iron and steel pipe.

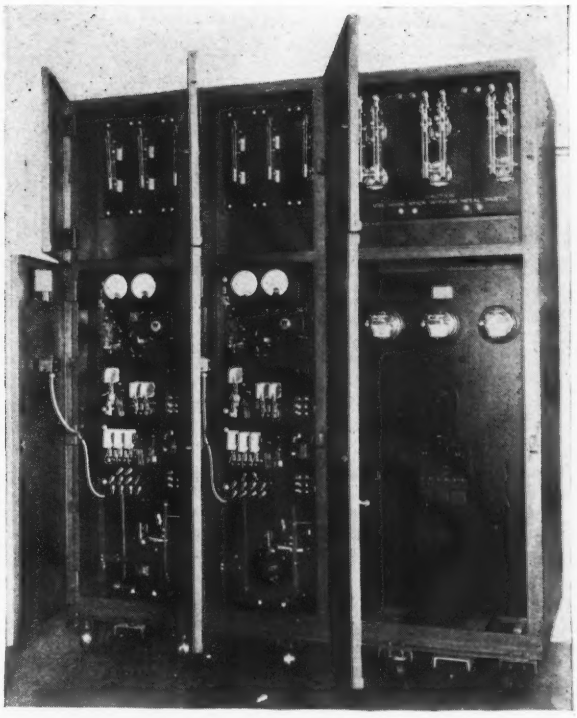
Toledo Pipe Threading Machine Co., Toledo, Ohio.

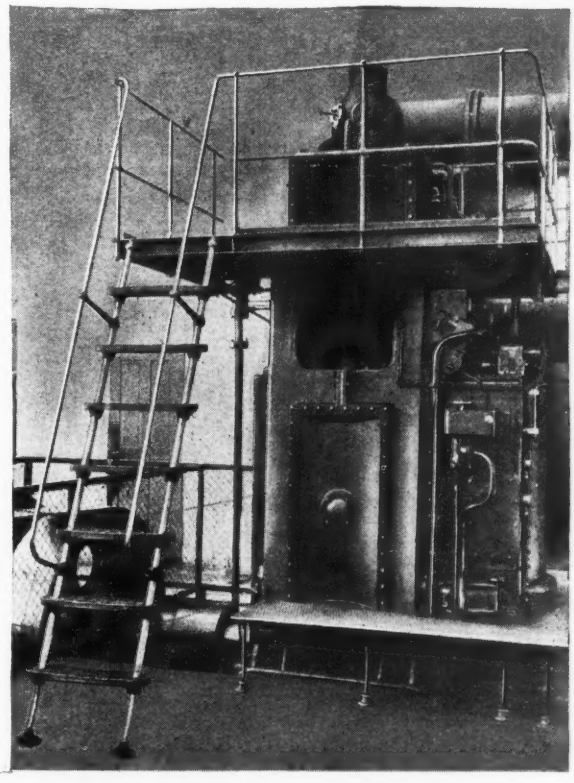


Galvanometer Suspension

Designed to provide stable means of support for instruments of the suspended-mirror type for all kinds of measurements, this suspension provides galvanometers of 1,100-megohm sensitivity with stable index line on a scale 9 m. distant. Described in Bulletin No. 149.

G-M Laboratories, Inc., 1731-35 Belmont Ave., Chicago, Ill.





Synchronous Motor Starter

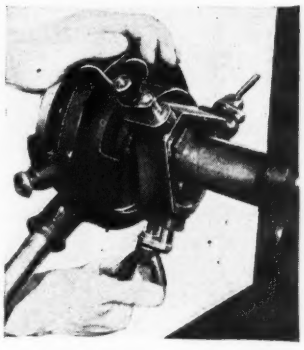
This synchronous motor starter, entirely inclosed in cubicles for protection against dust, has three compartments. One contains incoming line circuit breaker with disconnect switches; others house individual synchronous motor starters with electrically-operated breakers and individual disconnect switches. Each compartment provided with lock. Individual motor exciters controlled from motor-starting push-button.

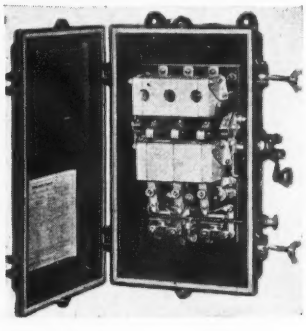
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Baffle Material

"Enco" plastic is special mixture of refractories that sets cold; unaffected by temperature changes found in boiler work. Will not spall nor be injured by moisture from use of soot blowers or washing boilers.

The Engineer Co., 17 Battery Place, New York, N. Y.

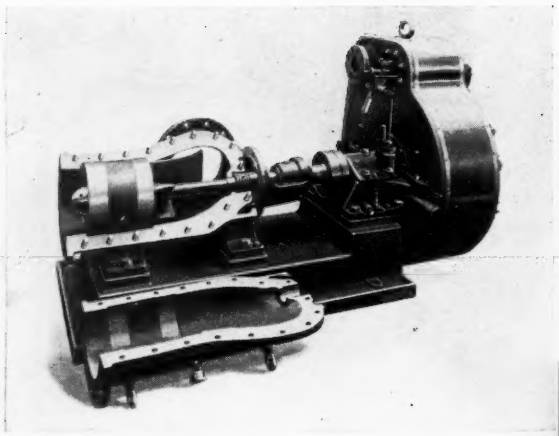




A. C. Combination Starters

A. C. combination starters of water- and dust-tight construction in cast-iron have been added to this company's line. Not explosion-proof. Unit consists of an across-the-line starter, motor control switch and test jack. Thermal overload protection and low-voltage protection provided. Starters built in two sizes, Class 8532S and 8536S; can be furnished fusible or non-fusible. Switch mechanism inclosed in cast-iron cabinet having machined flanges and fitted with rubber gaskets.

Industrial Controller Division, Square D Co., Milwaukee, Wis.



Propeller Pumps

For handling large volumes of liquid against low heads, this propeller pump is built for both horizontal and vertical installation. Available for all capacities and for heads up to about 40 ft. Can be direct-connected to standard speed electric motor or steam turbine, or speed reducing gear may be used. Pump casing in two parts, separated in plane of center line of shaft by a flat joint with gasket. Details of construction in illustration, showing casing cover removed and guide vanes and wearing sleeve about propeller.

De Laval Steam Turbine Co., Trenton, N. J.

Solenoid-Operated Gate Valve

Centralized control of steam, water and other process lines is made possible by this gate valve for steam pressures up to 125 lb. and water pressures up to 150 lb. Of relay servomotor type, with small solenoid actuating hydraulic motor. Lever shows position of valve and can be used for manual operation when necessary. Valves arranged to open to full pipe size and to operate at any desired speed.

Ruggles-Klingemann Mfg. Co., 38 Chauncy St., Boston, Mass.

Watertight Pushbutton Stations

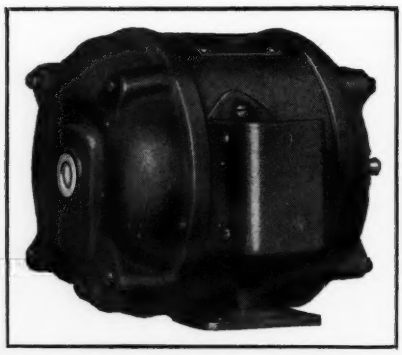
"C-H" master stations use levers instead of push-buttons to obtain water-tightness. Lever shaft operates through stuffing boxes and cover joint is sealed.

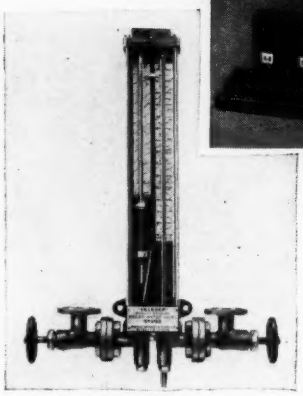
Cutler-Hammer, Inc., 294 N. 12th St., Milwaukee, Wis.

Direct-Reading Ohmmeter

This double-range ohmmeter is self-contained, measuring resistances easily. Resistance ranges from 5,000 to 50,000 ohms, selectable by switch.

Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

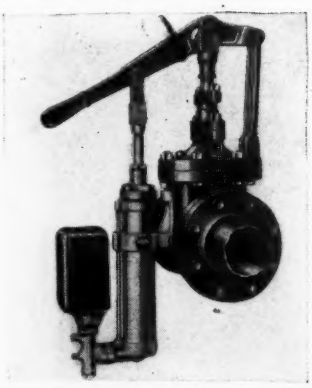


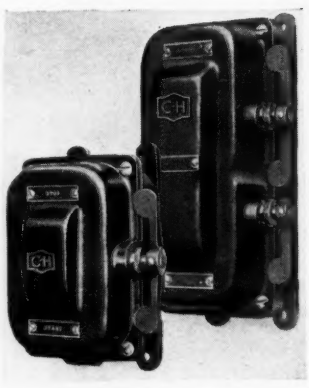


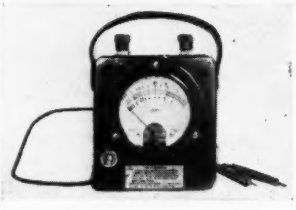
Boiler Water Level Gage

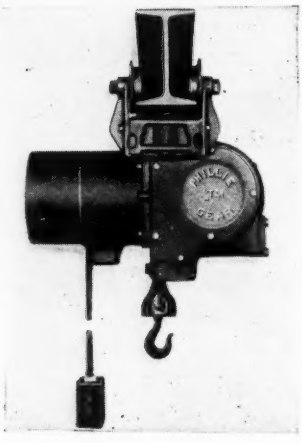
"Teledep" gages provide remote water level readings at any distance from boiler, gage is operated by water from boiler, operates cold (claimed to prevent temperature errors and gage glass breakage from excessive heat) uses only two pipe leads and valves, has two scales, water levels shown as readings above or below mean water level. Made of rustless materials with wire-embedded protector glass cover.

Dobbie, McInnes & Clyde, Ltd., 57 Bothwell St., Glasgow, Scotland.









Split-Phase Motors

Ratings from 1/60 to ⅓ hp. have been added to this line of split-phase motors. End brackets cast and designed to protect motors from falling objects, dust or dripping water. Frames rolled steel. Bearings phosphor bronze, with wool yarn system of lubrication.

Century Electric Co., St. Louis, Mo.

Boiler Water Test

Two outfits for controlling pH and phosphate content of boiler water are similar to slide comparator illustrated. Available separate or in combination. Color standards guaranteed for 5 years; pH outfit contains new indicator thymol red; color standard slide contains standards from 8.0-11.2 in intervals of 0.4 pH. Phosphate slide comparator claimed to eliminate errors from silicate, iron, etc. Color standard contains slides of 5, 10, 20, 30, 40, 50, 60, 80 and 100 parts per million of phosphate as PO_4. Procedure claimed simple.

W. A. Taylor & Co., Inc., 672 Linden Ave., Baltimore, Md.

Switchgear

To meet requirements of industrials, building equipments, and power station auxiliaries, this line of switchboards employs air circuit breakers for control and protection of power and lighting lines. Breakers are trip-free and can be manually or electrically operated. Ratings are up to 750 volts and 4,000 amp. a.c., and 6,000 amp.

General Electric Co., Schenectady, N. Y.

Rubber Packings

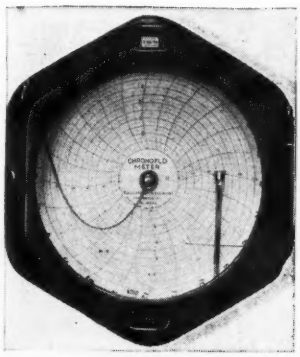
Diaphragms, disks, gaskets, etc., now of "Thiokol," a new chemical product with rubber characteristics but unaffected by solvents or oxidation. Recommended for use near gasoline, ether, kerosene, carbon tetrachloride and gas.

Garlock Packing Co., Palmyra, N. Y.

Electric Hoist

This hoist, in sizes from ¼ to 3 tons, has these features; high lift with low headroom, noiseless operation, no load break necessary, balanced so load is always under rail center, sealed operating mechanism, close control, short turning radius, interchangeability of parts, heavy-duty construction. Timken roller bearings and standard motor. Hoist push-button controlled. Special materials for operating parts.

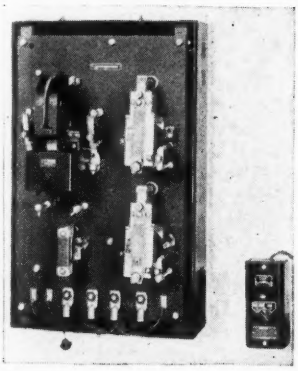
Philadelphia Gear Works, Erie Ave. & G St., Philadelphia, Pa.



Electric Flow Meter

Wide measuring range, accuracy, and abundance of power are claimed for the "Chronoflo" meter, claimed capable of keeping chart record reliable to 1/12 maximum rate, and total flow register accurate to 1/20 of maximum flow. May be used with either a Venturi tube or orifice plate, and is a combination of Telechron motor, mercury switch, power relay and electromagnetic clutch.

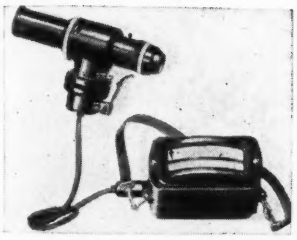
Builders Iron Foundry, 9 Codding St., Providence, R. I.



General-Purpose Mill-Type Starters

Designed for constant-speed direct-current motors, these starters utilize newly developed accelerated contactors designed to act both as a relay to provide time delay, and to short out starting resistor by means of a contact finger. Accelerating contactors are equipped with silver-faced tips to eliminate oxidation difficulties. Starters available from 1 to 75 hp.

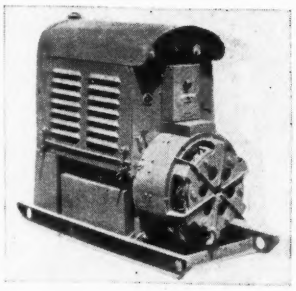
General Electric Co., Schenectady, N. Y.



Optical Pyrometer

"H-K" optical pyrometers, Holborn-Kurlbaum type, furnished with three-range telescope for measuring temperatures up to 2,600, 3,700 and 5,500 deg. F. Direct-reading scale with two ranges, 1,100-2,600 and 2,200-3,700 deg. F. Conversion table supplied for third range. Weighs 5 lb. and is 6x6x3 in. Teleobjective attached for observing small objects at great distance.

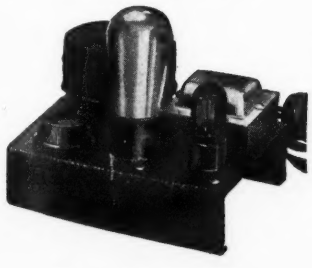
Bacharach Industrial Instrument Co., 7000-6 Bennett St., Homewood Station, Pittsburgh.



Ford-Engined Electric Plants

These 7½-kw., d.c. or a.c. "Ready-Power" power plants come either in self-cooled or marine types in all common voltages. Engine, starting motor, starting battery, charging generator, fan belt, ignition system, fuel pump and carburetor are manufactured by Ford Motor Co., as well as many small parts. Units are self-starting and use Ford Model B 4-cyl. water-cooled engines operating at 1075 to 1250 r.p.m. Generators have six-pole rolled steel frame with armature replacing engine flywheel.

The Ready-Power Co., 3820 Grand River Ave., Detroit.



Photoelectric Relay

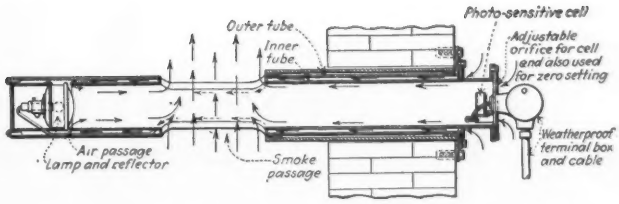
"Foto-Switch" photoelectric relay embodies electromagnetic switch opened or closed by interruption or variation in illumination on the cell. Used for light-beam control of motors or other electric devices, signals and alarms.

G-M Laboratories, Inc., 1731-35 Belmont Ave., Chicago.

Small A.C. Generators

These a.c. generators for emergency lighting in buildings, etc., have outputs ranging from 1½ kva. to 40 kva. Guarantced not to exceed 40 deg. C. temperature rise at full kva. load at 0.8 P.F., or 55 deg. C. at 25 per cent kva. overload. Provided with pulley for belt drive or coupling for direct. Timken bearings throughout. Single, 2- or 3-phase windings.

Columbia Electric Mfg. Co., 1292 East 53rd St., Cleveland.



Vacuum Pump and Compressor

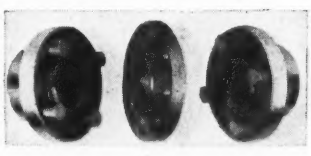
Nash cone-type "Hytor" vacuum pump and compressor has pump with but one moving part. New design for higher rotating speeds claimed to show increased vacuum, increased pressure, and greater efficiency. Incorporates cone within rotor hub containing two inlet and two outlet ports. Design claimed to permit freer passage of air in and out of rotor buckets and more nearly straight-line flow of air through pump. This permits use of wider rotor of smaller diameter, which in turn permits higher rotating speeds and increased efficiency coupled with compactness. Pump will maintain vacuum up to 28 in. mercury and pressures up to 35 lb. per sq.in.

Nash Engineering Co., 100 Wilson Rd., South Norwalk, Conn.

Oil Circuit Breaker

Type Y-100 circuit breakers are for indoor, high-amperage circuits of 7,500 volts or less. Inclosed-mechanism type with all poles in one tank, and offer non-oil throwing, high speed of operation, small space requirements and provision for venting. Furnished manually or electrically operated for 2,000 to 3,000 amp. at 7,500 volts or less, with estimated interrupting capacity of 100,000 kva.

Condit Electrical Mfg. Corp., 1344 Hyde Park Ave., Hyde Park, Boston, Mass.



Buffer Slot Coupling

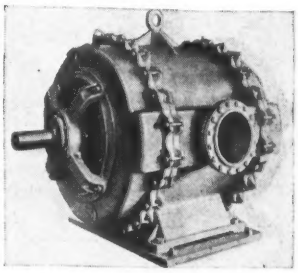
Buffer slots cut at regular intervals in flexible leather disk of coupling give flexibility and permit coupling to be used under angular and parallel misalignment and shock loads, according to maker.

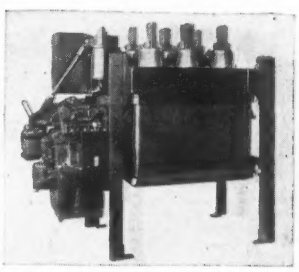
Brown Engineering Co., 123-127 N. 3rd St., Reading, Pa.

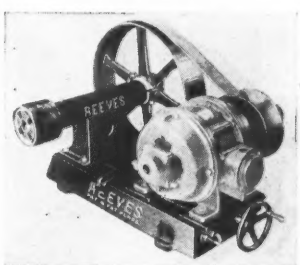
Smoke-Density Meter

This meter measures density of smoke in flue gases by optical means, a portion of gas passing between light source and photo-electric cell. Chart of instrument calibrated to read in per cent of smoke density, scale being readable either in per cent or in terms of Ringelmann scale. Preferred arrangement illustrated has advantage of requiring only one hole in stack or uptake. Sampling tube construction prevents soot or smoke accumulation on lamp or on light-sensitive device. Withstands up to 600 deg. F.

Brown Instrument Co., Philadelphia, Pa.





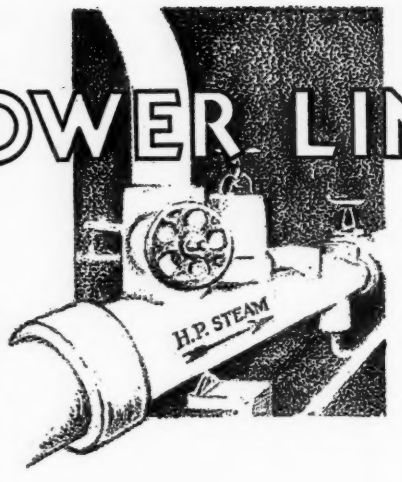


Speed-Control Unit

This vari-speed motor pulley countershaft unit is adaptation of Reeves vari-speed motor pulley unit. When handwheel is turned, motor and adjustable pulley are retracted from large pulley, causing belt to assume smaller diameters. The unit, in seven sizes, is available from fractional to 7½ hp.

Reeves Pulley Co., Columbus, Ind.

POWER LINES



Dr. Friedrich Sass, German Expert, Discusses Diesel Design

DR. FRIEDRICH SASS, chief engineer of the diesel division, Allgemeine Electricitats Gesellschaft, Berlin, Germany, has just returned to Germany after a 6-week visit to various diesel manufacturers. While here he presented a paper, "Some Recent Developments in Double-Acting Diesel Engines," before the Oil & Gas Power Division of the American Society of Mechanical Engineers, in which he described the designs and methods in use by his company.

Dr. Sass, previous to his presentation of the paper, visited the New York offices of *Power* in company with N. E. Groeneveld Meyer, his company's representative in this country, and discussed both the general diesel situation and developments in two-cycle diesels. In response to the question, "What do you think of the possibilities of the diesel engine for power services in America," he replied:

"I think there is a vast field for the diesel engine in the United States, especially because you have so many districts where oil may be cheap and coal perhaps more expensive or where power transmission lines would be too expensive. This is my opinion, and I find it to be the opinion of many of the diesel engine makers and

other people. They expect a revival in the near future of the diesel engine business, especially for municipal and small power stations. I share this opinion."

When asked the possible capacity limit of the diesel, particularly the two-cycle, double-acting unit, he replied:

"I am inclined to say that there is a limit, but that this limit has not yet been reached because there are no very large units in the world. A capacity of 2,500-hp. per cylinder, in a two-stroke cycle, double-acting, solid-injection engine, under present conditions, is about the limit. The number of cylinders is, of course, limited, but only by torsional vibrations in the crankshaft. If the number of cylinders increases beyond ten or twelve, it is more economical to make two engines. These could be up to about 25,000 hp. each, which might be raised to about 30,000 hp. by supercharging. I prefer not to supercharge for continuous running, but if the units are peak load engines, then moderate supercharging may by profitable. My opinion is that the materials we have today, especially for making the liners are not so that they can withstand for a long time these very high temperature and pressure stresses which would be increased by supercharging."

Dr. Sass' opinion was also asked regarding the cost of a complete diesel electric station compared with the cost of a corresponding steam-turbine station. His reply was: "I think the costs are practically the same per kilowatt. Germany has for some time claimed that they can get cheaper kilowatts with the diesel. The cost per kilowatt may be in the neighborhood of 200 or 250 marks ($50–$60). Some years ago it was 300 marks (about $75) (that includes the whole station").

Disastrous Boiler Explosion on "Observation" Unexplained

On the morning of Sept. 9, the 44-yr.-old steamer "Observation" was blown to bits in the East River, New York City, in one of the worst marine industrial accidents of the City's history.

The boat was crowded with workmen, bound from the Bronx for their jobs at the new $9,000,000 penitentiary on nearby Rikers Island. Many were killed instantly and others died during the days that followed, bringing the total casualty list to 71 killed and 63 injured.

Beyond question, this disaster resulted from the explosion of the boilers on the "Observation," but in spite of an extensive investigation by numerous individuals and official bodies, the cause of the explosion had not yet been determined when this number of *Power* went to press.

Investigators have been hampered by the fact that the explosion removed most of the evidence. However, extensive diving and grappling operations have resulted in the recovery of two boiler tubes and of the safety valve.

The valve, of the spring-loaded type, was marked for 150 lb. but relieved steam at 144 lb. It therefore appears that the boiler must have exploded at a pressure below its "safe" working pressure.

The boiler was a marine type H.R.T. unit with water leg, a type familiarly known as a "dog-house" boiler. Drum diameter was 78 in.

Robertson Outlines Employment Program

Plans for an intensive equipment modernization movement throughout industry as one means of breaking the unemployment deadlock now keeping more than 11,000,000 workers out of jobs have been outlined by A. W. Robertson of Pittsburgh, chairman of the national Committee on Industrial Rehabilitation and chairman of the board of the Westinghouse Electric and Manufacturing Company.

The committee headed by Mr. Robertson was initiated in Washington at the recent conference of Banking and Industrial Committees of the twelve Federal Reserve districts called by President Hoover and attended by ranking officials of the government. The committee is immediately concerned with a plan to put back on pay-roll 1,620,000 workers out of employment in factories manufacturing machinery, equipment and plant facilities.

The program will concentrate on an effort to get manufacturers in all of the nation's principal production centers to modernize their plants now.

The names of industrial and business executives who will serve as chairmen of action committees in the Federal Reserve districts and industrial areas are as follows:

Chairmen of Federal Reserve district committees:

First District (Boston): Harry C. Knight, president of the New England Council and president of the Southern New England Telephone Company, New Haven, Conn.

Second District (New York): Major General James G. Harbord, chairman of the board of the Radio Corporation of America.

Third District (Philadelphia): John E. Zimmerman, president of the United Gas Improvement Company. Vice chairman: Charles Brinley, president of the American Pulley Company, Philadelphia.

Fourth District (Cleveland): Randolph Eide, president of the Ohio Bell Telephone Company. Vice-chairmen: George C. Brainard, president of the General Fireproofing Company, Youngstown, and Earle Martin, formerly Industrial Commissioner of the Cleveland Chamber of Commerce.

Fifth District (Richmond): W. H. Meese, vice president of the Western Electric Company, Baltimore. Vice-chairman: J. E. Sirrine, president of J. E. Sirrine and Company, Greenville, S. C.

Sixth District (Atlanta): Theodore Swann, president of The Swann Corporation, Birmingham, Alabama.

Seventh District (Chicago): Appointment to be made.

Eighth District (St. Louis): Albert B. Elias, president of the Southwestern Bell Telephone Company. Vice-chairman: P. B. Postlethwaite, president of the Wagner Electric Company, St. Louis.

Ninth District (Minneapolis): R. F. Pack, president of the Northern States Power Company, Minneapolis.

Tenth District (Kansas City): Frank Moss, president of the American Sash and Door Company, Kansas City, Mo.

Eleventh District (Dallas): R. L. Thornton, president of the Mercantile National Bank and Trust Company, Dallas. Vice-chairman: R. C. Kuldell, president of the Hughes Tool Company, Houston.

Twelfth District (San Francisco): William A. Ross, vice president of the Columbia Steel Company. Vice-chairman: J. A. Cranston, General Electric Company, San Francisco.

N.A.P.E. Celebrates Golden Jubilee At Annual Convention in Milwaukee

MILWAUKEE, WIS., was host to the National Association of Power Engineers Sept. 5-10. The association celebrated the fiftieth year of its existence there, and the Great Lakes Power Conference, with the Great Lakes Power & Mechanical Exposition, was held simultaneously at the Milwaukee Auditorium.

More than three hundred delegates and guests attended the N.A.P.E. convention and participated in the meetings.

David E. Lilienthal of the Public Service Commission delivered the address of welcome to the state on Tuesday the sixth. Nat. Pres. Lisle A. Pierson responded. The mayor of the City of Milwaukee, David W. Hoan, then welcomed the association to the city and was answered by Albert F. Thompson, national vice-president. Following presentation of the gavel to the national president by J. A. Prudell, Local Committee Chairman, the business of the convention was begun.

Simultaneous sessions of the Engineering Committees of the Great Lakes Division of the National Electric Light Association, the American Society of Heating and Ventilating Engineers and the Universities and colleges group were held in the afternoon.

On Wednesday the seventh, Grover Kieth of the Marathon Paper Company spoke on "Power in Industrial Plants Using Process Steam," and other papers were read by H. E. Koch, "Nitriding and Other Electrical Furnaces"; J. S. McMillen, "Experiences with Oil Engines"; air conditioning discussions by E. W. Atkinson and others.

Thursday was devoted mostly to business meetings, and Friday the ninth the annual election was held. The new national officers for the ensuing year are:

Albert F. Thompson, Kansas City, president.

J. A. Prudell, Milwaukee, vice-president.

Fred W. Raven, Chicago, secretary.

Samuel B. Forse, Pittsburg, treasurer.

Buffalo was selected for the convention of 1933.

The Power Show was fully up to the high standard of former years. Some eighty-six of the leading manufacturers of power equipment and auxiliary apparatus participated. A noticeable spirit of confidence and anticipation of improved business for the new year was prevalent. Some manufacturers spoke of having already felt the effect of greater confidence in many industries as evidenced by more orders for equipment needed for the reconditioning of power plants. It is evident that a large number of power plants for industrial institutions are getting ready to start up again. This even extends to the coal mines. It is apparent that those who supply fuel see a coming demand for their product that can only mean a welcome change for the better in all directions.

Beauharnois Hydro Project Goes Into Operation

After nearly three years of construction work, the Beauharnois power project of the Beauharnois Power Corporation on the St. Lawrence River was recently put into service. The plant started delivering power to the Ontario Hydro-Electric Power Commission and to the Montreal Light, Heat & Power Co. Oct. 1, thus meeting the requirements of the Beauharnois Corporation's long-term contract for 400,000 hp. at $15 per hp.yr. The initial installation consists of two 50,000-hp. 25-cycle, and two 50,000-hp. 60-cycle main units and two 8,000-hp. service units.

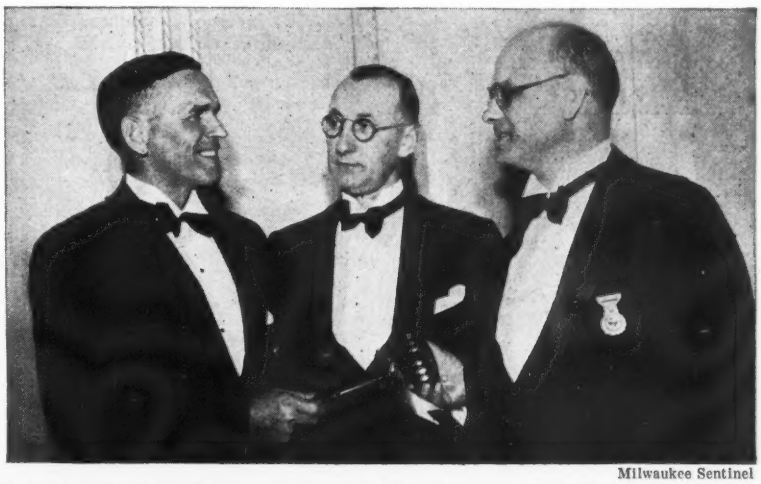
This project is a combination power and deep-water navigation development and is one of the three involved in harnessing the St. Lawrence River. Between Lakes St. Francis and St. Louis there is a fall of 83 ft. To utilize this fall a canal 15 miles long with a minimum width at water level of 3,000 ft. has been constructed. A channel 600 ft. wide and 27 ft. deep has been dredged for the full length of the canal. As more water is required the canal will be deepened to 27 ft. for its full width. The unusual width of the canal is made necessary by navigation's requirements and the large power that will be developed.

The initial undertaking is for 500,000 hp., but it is planned eventually to produce 2,000,000 hp., at which time the entire flow of the St. Lawrence River will be used. To meet the needs of navigation the flow in the canal will be kept to 2.5 ft. per sec. The power house has been planned so that it can be extended until it is 3,000 ft. long to accommodate forty 50,000-hp. main units. The dam at the lower end of the canal and the power-house substructure are reinforced-concrete monolithic structures.

A feature of the power-house design is placing the operating control for the generators on the turbine floor instead of on a level with the generators. This arrangement was chosen because such operations that still must remain close to the units pertain more to the bearings, brakes, governors and couplings than to the alternators.

Oil Burner Show To Be Held in Chicago

The tenth annual convention and show of the oil burner industry will be held in Chicago at the Hotel Stevens during the week of June 11, 1933, in conjunction with the opening of the "Century of Progress," according to announcement by Morgan J. Hammers, president of the Association.



Milwaukee Sentinel

Incoming President Thompson accepts the gavel from Past-President Pierson

PERSONALS

GEORGE B. MULLOY, specialist for the past 25 years in the design and operation of power plants, has become a partner in Brady & McGillivray, which now becomes Brady, McGillivray & Mulloy, with offices on the ninth floor of the Old Colony Bldg., 37 W. Van Buren St., Chicago, Ill.

M. SCHILLER, in addition to his duties as vice-president of The Superheater Co., 60 E. 42nd St., New York, N. Y., has been elected treasurer to succeed W. F. Jetter, recently resigned. F. J. Dolan was elected assistant secretary and assistant treasurer. Thomas F. Morris was elected treasurer and assistant secretary of The Superheater Co., Ltd., of Montreal, to succeed W. F. Jetter, resigned.

S. A. HADLEY, 609 Interstate Bldg., Kansas City, Mo., has been appointed sales representative in the Kansas City territory for boilers, engines, turbines, reduction gears and unit heaters by Murray Iron Works Co., Burlington, Iowa.

HARVEY LEFEVRE, formerly sales manager of the H. K. Porter Co., Pittsburgh, has joined the Heisler Locomotive Works, Erie, Pa.

C. G. ONG, formerly manager of the small turbine department, Westinghouse Electric & Mfg. Co., has become New York agent with offices at Room 1610, 15 Park Row, for the Murray Iron Works Co., Burlington, Iowa.

JACK CARSON, formerly with Libbey-Owen Glass Co., has joined the Corning Glass Works, which has recently purchased the gage glass department of Libbey-Owens.

THOMAS M. JONES has been appointed general sales manager of the Keystone Lubricating Co., 21st, Clearfield & Lippincott Sts., Philadelphia, Pa.

LOUIS E. UNDERWOOD, managing engineer of the stationary motor engineering department of General Electric Co. at Lynn, Mass., has been appointed manager of the Pittsfield, Mass., works to succeed E. A. Wagner, retired.

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Diesel Production

The accompanying table, giving statistics on the production of diesel and semi-diesel engines in 1931, is compiled from data collected at the biennial census of manufactures taken in 1931. Figures given are preliminary and subject to correction. The information has been released by the Bureau of the Census of the U. S. Department of Commerce.

GERARD SWOPE, president of the General Electric Co., has been awarded the 1932 manufacturers' medal and purse given under the James H. McGraw Award, by the judges of the National Electrical Manufacturers Association. This is in recognition of his contribution to the advancement of the manufacturing branch of the electrical industry by developing a plan for stabilizing employment through cooperative action by industries out of which the N.E.M.A. Mutual Unemployment Benefit Plan has been evolved. Presentation of the award was made Sept. 26 at a meeting of the N.E.M.A.

R. J. BENDER, formerly with the Whiting Corp., in the pulverizing & combustion division, has resigned to join the sales department of Sinclair Refining Co. as combustion engineer.

GEORGE G. VAN TUYL has been appointed district manager at the Cleevland, Ohio, office of Riley Stoker Corp. Worcester, Mass.

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BUSINESS NOTES

THE RAWLPLUG CO., INC., New York, N. Y., has appointed C. K. Cairns Co., 119 E. 5th St., Cincinnati, Ohio, as its representative in that district.

MACHINERY & WELDER CORP., formerly at 2604 N. Cicero Ave., Chicago, Ill., moved Aug. 1 to new and larger quarters at 316 N. Sheldon St., Chicago.

MCCLAVE-BROOKS CO., Scranton, Pa., has appointed Charles M. Setzer & Co., 608 Builders' Bldg., Charlotte, N. C., as exclusive sales representative for the states of North and South Carolina.

DAVIS ENGINEERING CORP., 90 West St., New York, N. Y., has appointed Fred W. Carlson, 959 Harrison St., Seattle, Wash., at representative in that territory.

AN ARRANGEMENT has been completed for joint use of the manufacturing, engineering, sales and service facilities in the Meter division of Worthington Pump & Machinery Corp. and those of the Gamon Meter Co., 282-296 South St., Newark, N. J.

G. E. TENNEY has been appointed sales manager of the Chicago district of Lincoln Electric Co., Cleveland, Ohio.

CENTRIFIX CORP., 3029 Prospect Ave., Cleveland, Ohio, has appointed Parry Engineering Co., 3216 Chrysler Bldg., as sales representative in New York.

JOHN B. FOLEY, JR., 510 Hills Bldg., Syracuse, N. Y., has been appointed representative for Coppus Engineering Corp., Worcester, Mass., in that district.

INDUSTRIAL TRADING CORP., 227 Fulton St., New York, N. Y., has been formed by Louis M. Vidal, president, and V. D. Demarest, secretary-treasurer, to deal in power and heavy contractor's equipment.

BERNITZ FURNACE APPLIANCE CO., 89 Broad St., Boston, Mass., has appointed Insulation & Refractories Co., 841 Elmwood Ave., Buffalo, N. Y., as representative for western New York State. LLOYD R. LEATHERMAN, formerly of the Bernitz New York office has been appointed district sales manager of the Chicago and Detroit district, with offices at 360 N. Michigan Ave., Chicago.

KIELEY & MUELLER, INC., 34 W. 13th St., New York, N. Y., has appointed F. G. Hartley Co., Perkins Bldg., Tacoma, Wash., agent for its full range line of pressure-control devices and allied specialties in the Pacific Northwest.

THE SPADE-THAYER CO., 308 Bird Ave., Vandercook Lake, Jackson, Mich., has been organized to manufacture a diversified line of steam specialties, including a full line and range of steam straps. H. E. Spade, president and chief engineer, was formerly in the employ of the Armstrong Machine Works at Three Rivers, Mich., in the latter capacity.

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OBITUARIES

THADDEUS REYNOLDS BEAL, president and chief executive for 32 years of the Central Hudson Gas & Electric Corp. and its predecessors, died Aug. 10.

ROBERT LEONARD SHERATON, 60, power equipment specialist for 30 years, chiefly in metropolitan Boston, and lately representative of the Hagan Corp. there, died suddenly, Sept. 2, at his home in Newton, Mass.

THOMAS WALTON SMITH, formerly superintendent of the water-tube boiler department of Kingsford Foundry & Machine Works, Oswego, N. Y., died there recently after an illness of 24 years. He had been a reader of *Power* for many years.

	Number of establishments reporting	Production of diesel and semi-diesel engines — Total — Number	Rated horsepower capacity	Value	Number, by horsepower capacity (rated or normal, not overload) — 5 or more but under 10	10 or more but under 20	20 or more but under 50	50 or more but under 100	100 or more but under 200	200 or more but under 400	400 or more but under 1,000	1,000 or more but under 5,000
Total	42	1,504	307,262	$13,407,781	66	116	298	288	325	197	148	66
Diesel (compression-ignition), total	34[1]	1,318	291,603	12,877,179	48	61	224	272	315	196	142	60
Marine (for direct connection to propeller shaft)	23	559	101,613	4,768,628	1	12	142	105	159	74	58	8
Other types of compression-ignition engines	22	759	189,990	8,108,551	47	49	82	167	156	122	84	52
Semi-diesel (surface-ignition)	8	186	15,659	530,602	18	55	74	16	10	1	6	6

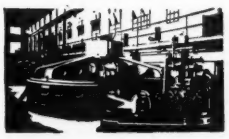
[1] The difference between the net total number of plants engaged in the manufacture of diesel engines, 34, and the sum of the numbers engagedi n the manufacture of marine engines and other types, 45, is due to the fact that 11 plants made both marine and other types of engines.

STRAWS

Pointing the way the business wind blows

A total of $8,800,000 will be spent in emergency relief construction on naval projects; $1,077,000 allocated to power-plant construction and improvements. These include improvement of power plant, Portsmouth, N. H., Navy Yard, $250,000; power plant, Boston Navy Yard, $50,000; Fort Mifflin, Pa., Naval Ammunition Depot, heating plant, $65,000; San Diego Training Station, heating plant, $180,000; Mare Island Navy Yard, power plant, $325,000; Naval Ammunition Depot at Mare Island, $50,000 for steam line; Puget Sound Navy Yard, power plant improvement, $100,000; and Keyport, Wash., Naval Torpedo Station, power plant extension, $57,000. Other items include distribution systems, underground wiring, power cables, etc.

Westinghouse Electric & Mfg. Co. recently received a $275,000 order for a 12,500-kw. turbo-generator from the Hawaiian Electric Co. The order follows shortly after $100,000 worth of wire and cable business placed by this company with Anaconda and Okonite.



When a Man Bites a Dog—That's News! Champion Rivet Co., Cleveland, after forty years of making rivets, has announced a new line of general-purpose welding rods, and has announced a new method of welding in which the special equipment necessary is supplied gratis with the first purchase of rod or wire.

Reconstruction Finance Corp. will aid the Metropolitan Water District of Southern California to the extent of $40,000,000 in financing construction of the proposed Colorado River aqueduct. Actual work on the $220,000,000 project probably will be started within the next six weeks or two months.

Glen Alden Coal Co., Scranton, Pa., is building a new boiler plant to serve its Stanton and Empire collieries. Equipment will include two 500-hp. Heine three-drum bent-tube boilers with economizers, two 665-hp. boilers without economizers and Coxe stokers.

Fort Collins, Colo., has passed a charter amendment which acts as a mandate on the council to build a light and power plant at a cost not to exceed $745,000. Revenue bonds in this amount have been authorized.

Cummins Engine Co., Columbus, Ind., is working 24 hours a day and cannot keep up with orders. The company is constructing a 20,000-sq.ft. addition to its plant and has already purchased new equipment to be installed in it.

Otis Elevator Co. has been awarded a contract for furnishing and installing 14 new elevators in the Oliver Bldg., Pittsburgh, to cost $600,000.

Michigan Alkali has stepped up production 100 per cent in its new solid carbon dioxide plant at Wyandotte, Mich., now producing 120 tons a day, working 24 hours a day, three shifts of 8 hours each. They expect to install additional equipment this Fall to take care of considerably increased production scheduled for next year.

King Refractories Co. reports a wide extension of activity in the reconditioning of boiler furnaces at widely scattered points from the Atlantic Seaboard to the Mississippi. Orders have been coming in for the past sixty days at a rate almost without precedent, even in best times. Work in hand includes several coal companies, and the presumption is that these have orders ahead or have assurance of business from the power companies, otherwise the expense of the changes could not be justified.

General Electric Co., Pittsfield, Mass., has announced that production of boiler units for their new oil-burning furnace has been stepped up 100 per cent to meet demands. All available electrical welders have been recalled for this work. At the Schenectady Works of General Electric 300 have been put back to work on the manufacturing schedule on both recently announced oil furnace and humifilter. Orders for this equipment promise to keep the new air-conditioning department busy for some time.

New equipment, including a diesel engine, air compressors, ball mill, classifiers, thickener, and concentrating tables, is being installed at the Buckskin gold property near Yearington, Nev. A mill is to be installed also.

The Grand Forks, B. C., municipal hydro-electric plant was opened Sept. 15 by the Governor-General of Canada. This plant is the only municipal hydro-electric enterprise in Canada built and paid for exclusively with money subscribed by the citizens of the municipality.

Harnischfeger Corp. has just completed the largest power-house crane ever built for the power house at the Diablo Dam, on the Skagit River, in Washington. The 300-ton, two-trolley, traveling crane will be used in erecting and repairing the 83,000-hp. hydraulic power plant. It weighs approximately 392,800 lb.

Transformers and transformer room equipment, heavy-duty motors and controls, elevating and conveying machinery, etc., will be purchased for Cedar Mountain Coal Co., Seattle, Wash., in Whatcom County fields. Total cost over $750,000.

B. C. Electric Railway Co. has begun construction of a new dam on North Barriere Lake, near Kamloops, B. C. Company crews will carry out the work, which is expected to cost about $50,000.

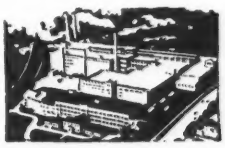
Stone & Webster Engineering Corp. has been authorized by Potomac Electric Power Co. to place a contract with General Electric Co. for a 35,000-kw. turbine generator unit to be installed in the $5,000,000 power station at Buzzard Point, in Washington, D. C.

May Oil Burner Corp., Baltimore, has received a recent order to equip the entire Vatican City of Rome with automatic oil burners.

Columbia Power Co., Golden, B. C., is planning to purchase the electrical distribution system at Smithers, B. C., now owned by Smithers Electric Co.

Shaughnessy Military Hospital, Vancouver, B. C., is now installing automatic coal stokers having a feed capacity of 180 to 550 lb. per hour.

Some large installations of electric boilers are being made in plants of pulp and paper industries in the Province of Quebec. This method of producing steam for industrial purposes has been in use in the province for many years. Wayagamack mill of Consolidated Paper Corp., Ltd., at Three Rivers, is installing a 40,000-kw. electric boiler which will supply up to 120,000 lb. of steam per hour, and a similar electric boiler is being put into operation at the paper mill of Anglo Canadian Pulp & Paper Mills, Ltd., Limoilou, near Quebec. A 25,000-kw. boiler is being installed in the plant of St. Lawrence Paper Mills Co., at Three Rivers.



In approximately the last twelve months more than twelve municipally or state-owned power plants have added new equipment or erected entirely new installations for power generation.

A Philadelphia manufacturer of blow-off valves reported June and July sales as the largest since last September.

A turbine manufacturer reports increasing interest on the part of industries in making their own power, and that his plant is operating at present sixteen hours a day on Navy contracts together with a small amount of commercial business.

The elevator installation for the Veterans Administration Building at Mt. Alto has been awarded, and calls for a push-button control passenger elevator with a capacity of 3,000 lb. and to operate at a speed of 75 ft. per min.

The plants and facilities of the Hershey Chocolate Company, Hershey, Pa., are to be improved shortly at an expenditure of six million dollars.

A 450-hp. diesel engine has been ordered by the New Allen Roller Mills, New Allen, Pa.

Consolidated Gas, Electric Light & Power Co., Baltimore, Md., has installed a dust collecting fan in place of its induced-draft fan for its 12,500-sq. ft. boiler at the Terminal Power Station. The fan will produce 4-in. draft when developing 5,000 hp. and at the same time collect fly ash and cinders otherwise eliminated through the stack.

New Bulletins

JET CONDENSERS—Pennsylvania Pump & Compressor Co., Easton, Pa., has issued Bulletin No. 411, describing the company's jet condensers and auxiliaries for vacuum processes. The products will be marketed by Byer Engineering Associates, 75 West St., New York, N. Y.

COOLERS—Niagara Blower Co., 6 E. 45th St., New York, N. Y., has issued a series of booklets on cooling equipment, including brine spray coolers, aluminum blast cooling coils and similar units. The bulletins are Nos. 33 and 34.

FIRE-TUBE BOILERS—Union Iron Works, Erie, Pa., has issued a new bulletin describing Union universal boilers of both the brick-set and steel-cased types.

WELDED PIPE & FITTINGS—Taylor Forge & Pipe Works, P.O. Box 485, Chicago, Ill., has issued a booklet on the company's welded pipe and fittings.

CONTINUOUS BLOW-OFF EQUIPMENT—Cochrane Corp., North Philadelphia, Pa., has issued Bulletin 692, describing the continuous blow-off equipment manufactured by that company.

GLASGOW—The Development Board for Glasgow & District, 72 St. Vincent St., Glasgow, C.2, Scotland, has issued a book, "Glasgow," describing the industrial community and including information regarding the power plant and electrical generating equipment.

REFRIGERATION — York Ice Machinery Corp., York, Pa., has issued a book "Cold Magic," describing the progress of refrigeration during the past half century. It is a splendidly illustrated description of the manufacture and utilization of the company's refrigerating equipment.

INDUSTRIAL RUBBER GOODS—B. F. Goodrich Rubber Co., Akron, Ohio, has issued a book of engineering data on industrial rubber goods, including a guide to the selection of belting, hose and other products. It is available upon request from the company, and includes a series of tables on rubber transmission belting, conveyor belts and similar information.

TEMPERATURE CONTROLLERS—Foxboro Co., Foxboro, Mass., has issued Bulletin 177 on "Temperature Controllers," describing the various types of equipment manufactured by the company, giving specifications and design information, including certain engineerng data.

AIR-COOLED TRANSFORMERS — Wagner Electric Corp., 6396 Plymouth Ave., St. Louis, Mo., has issued a loose-leaf bulletin sheet describing Wagner Types AC and AA units in sizes 1 to 50 kva., voltages 100 to 600 and discussing their application. It is known as Part 4B of Bulletin 172.

STEAM TURBINE UNITS—Allis-Chalmers Mfg. Co., Milwaukee, Wis., has issued Bulletin No. 1160 on "Steam Turbine Units, 3,600 R.P.M." describing the units and their application.

VARIABLE-SPEED TRANSMISSION — Reeves Pulley Co., Columbus, Ind., has issued Catalog No. 99, describing the various types of variable-speed transmission and units manufactured by the company and listing their aplication.

SPLASH-PROOF MOTORS—General Electric Co., Schenectady, N. Y., has issued GEA-1619, describing the company's splash-proof motors in squirrel-cage induction type from ½ to 75 hp.

AIL-COOLED TRANSFORMERS — General Electric Co., Schenectady, N. Y., has issued GEA-897B, superseding GEA-897A, describing Types M and D G.E. air-cooled transformers.

B & W CATALOG—Babcock & Wilcox Co., 85 Liberty St., New York, N. Y., has issued a complete catalog describing design and construction and operating characteristics of modern equipment for power, industrial and process plants, and including discussion of the new engineering developments of the company. The company has also issued a 16-page bulletin "Four to Six Per Cent Chromium Steel Tubes and Pipe."

COMPRESSORS—Worthington Pump & Machinery Corp., Harrison, N. J., has issued the following publications: "Portable Compressors, and Contractors Air Tools"; "Hydraulic By-pass and Check Valves"; "Power Pumps for Marine Boiler Feed Service"; "Steam Pumps for Marine Service"; "Steam Pumps for Highly Volatile Liquids."

New Plant Construction

McGraw-Hill Business News Department Is Prepared to Furnish a More Complete Daily Service

Ala., Birmingham — Selma Mfg. Co., 1700 Vanderbilt Rd., plans power plant. $35,000.

Ark., Fort Smith — City municipal power plant. Burns & McDonnell Engr. Co., 400 Interstate Bldg., Kansas City, Mo., engrs.

Ark., Paragould — City, W. C. Middleton, mayor, election Oct. 24, $100,000, municipal light and power plant, equipment and distribution system. W. A. Fuller Co., 2916 Shenandoah Ave., St. Louis, Mo., engrs.

Calif., Fresno—Fresno-Madera Ice Co., Blackstone Ave., plans by C. E. Butner, Cory Bldg., 1 story, 40 x 100 ft., brick, Blackstone Ave.

Calif., San Pedro—Pacific Carbonic Co., T. F. Pattinson, mgr., R.F.D. 2, Box 143, Orange, dry ice manufacturing plant, Terminal Island, $200,000, incl. equipment.

Colo., Englewood — Voted $750,000, new waterworks and power plant.

Colo., Ft. Collins—City, election within 60 days, $745,000, municipal light and power plant. Burgess C. Coy, city engr.

Conn., Torrington—Torrington Ice Co., plans by R. E. Palmer, 56 Suffolk St., Holyoke, brick, concrete plant, ice manufacturing plant, North Main St. $30,000.

Ill., Morris — City preparing plans pump house, 1,400 ft. well, pumps, motors, etc. $35,000. H. A. Tollberg, City Hall, Ottawa, engr.

Ia., Atlantic—City, T. E. Nichols, clk., brick, concrete power plant, equipment, distribution system. $123,000. Burns & McDonnell Eng. Co., 406 Interstate Bldg., Kansas City, Mo., engrs.

La., Bogalusa—Bogalusa Paper Co., Inc., M. E. Cody, genl. mgr., Bogalusa, survey now being made by United Engineers & Constructors, Inc., consult. engrs., 112 North Broad St., Phila., Pa., and report completed by time of election Oct. 11, when city will determine if taxation exemptions for 5 years on improvements will be given, new bleaching plant, new additions to No. 1 and 2 paper machines, new wood room equipment, sulphate recovery system, boilers and turbo-generators, evaporators, pump washers, pulp screens, lime burners, vacuum pump, etc.

La., Shreveport—Con. Q.M., Parksdale Field, completed plans hospital $225,000; 2 barracks buildings, $316,000; cold storage unit $15,000; completing garages $30,000, for Parksdale Field.

Mass., Charlestown — Yards & Docks, Navy Dept., Wash., D. C., plans brick, steel power plant, Navy Yard. $100,000.

Mass., Hudson — Town, Municipal Light & Power, L. D. Wood, mgr., taking bids brick power plant addition, Brookside Ave., $30,000. E. V. Aldrich, 46 Lincoln St., archt.

Mich., Bessemer—Municipality, L. F. Mueller, clk., municipal lighting and power plant. $140,000.

Minn., Mahtomedi—Village municipal power and light plant. $25,000. P. R. Banister, North St. Paul, engr.

Minn., Elk River—Municipality plans power plant. $80,000. R. W. Richardson, New York Life Bldg., St. Paul, engr.

Mo., Washington—City, F. J. Ruether, mayor, election $400,000, concrete, brick light and power plant, incl. equipment, distribution system, etc. Burns & McDonnell Eng. Co., 406 Interstate Bldg., Kansas City, engrs.

Neb., Omaha — Metropolitan Utilities Dist., 18th and Harney Sts., 2 story, 27 x 65 ft., concrete, brick, steel generator and blower, 20th and Center Sts., local labor. $62,500.

N. J., Highland Park—Mrs. E. R. Johnson, River Rd., rebuilding 2 story, basement, brick, steel, heating plant and farm building, River Rd. $40,000. Maturity soon.

N. Y., New York—New Amsterdam Brewing Co., H. L. Noll, pres., 10 East 40th St., brewery, incl. brewhouse, stock house, power house, office, garage and bottling plant. $2,500,000.

O., Cincinnati—Cincinnati Rubber Co., Franklin Ave., soon takes bids altering power plant. $75,000. A. M. Kinney, Dixie Terminal Bldg., engr. and archt.

O., Defiance—Owner, c/o J. R. Pollock, Defiance, plans electric light plant.

O., Martins Ferry — Syndicate, c/o T. W. Pursglove, Martins Ferry, electric power plant. $125,000.

S. C., Anderson—Appleton Mfg. Co., power plant alterations, incl. new boilers, etc., separate contracts awarded. $75,000.

S. D., Aberdeen—City bids about November, electric light and power plant, stokers. $900,000. Bemis Co., 105 West Adams St., Chicago, Ill., engr.

S. D., Canton—City electric light and power plant and distribution system. $115,000. Buell & Winter, 503 Insurance Bldg., Sioux City, Ia., engrs.

Tex., Dallas—City, c/o J. N. Edy, mgr., new watermains in 1933, $225,000; improvements to Bachman pumping and purification plant in 1934, $200,000; fire hydrants, water meters and other improvements under the 6-year program of Water Dept. improvements. Total est. $1,763,800. O. H. Koch, dir. P. Wks.

Utah, Pleasant Grove—City plans either hydro-electric or diesel power plant. $25,000. Engineer not appointed. L. Olpin, mayor.

Ont., North Bay—City, constructing rein.-con. sewage disposal plant or 2 sewage pumping plants with chlorine equipment for treatment of effluent. $30,000-$50,000. F. G. Mackie, City Hall, engr.

Switzerland—Swiss Federal Railroads, Berne, plans electrification program, incl. 400 kilometers of additional electrification of system, power plant for same, incl. construction dam and 26,000,000 cu.meter reservoir, near Einsiedeln. To exceed $1,000,000.

Union Soviet Socialist Republic—Soviet Government, c/o Amtorg Trading Corp., 261 5th Ave., New York, plans series of test wells and surveys in progress pipe line, refineries, and power plants at Sterlitamak Oil Fields, Urals.

Equipment Wanted

PUMPS—**San Luis Obispo, Calif.**—Supervs. San Luis Obispo Co., rescinded contract distributing system and pumps for Cambria Water Dist.

PUMPING UNITS—**Wash., D. C.**—Oct. 5, by U. S. Eng., 1068 Navy Bldg., 4 vertical motor driven pumping units for booster pumping plant.

OPERATING MACHINERY—**Illinois**—Oct. 15, by U. S. Eng., 1st Dist., Chicago, operating machinery for lock gates at Kampsville and LaGrange Locks, Illinois Waterway.

DIESEL or GASOLINE MOTOR—**Trenton, Ill.**—Walter Germain in market 60-hp. Diesel or gasoline motor.

PUMPS, MOTORS, etc.—**Indianapolis, Ind.**—Oct. 4, by Bd. Sanitary Comrs., fabricating, installing 32 digesters with agitators, in garbage reduction plant, also cenrtifugal pump, motors and pit for same. $30,000. O. C. Ross, 103 City Hall, pres.

TURBINE—**Peru, Ind.**—City Council, purchasing and installing 5,000 kw. turbine for city light plant. $100,000. C. H. Brossman, 1009 Chamber of Commerce Bldg., Indianapolis, engr.

PUMPS—**Fontanelle, Ia.**—City, 4,200 lin.ft. 4 in. c.i. pipe, suction pump and pump house. K. Young, 1034 Redick Tower, Omaha, Neb., engr.

CENTRIFUGAL PUMPS—**Portsmouth, N. H.**—Oct. 5, by Yards & Docks, Navy Dept., Wash., D. C., 2 centrifugal pumps with dual turbine and motor drive, and one centrifugal pump with motor drive. Bid should include services of a skilled erector.

BOILER, etc.—**Slippery Rock, Pa.**—Comm. State Teachers College, J. L. Eisenberg, pres., preparing plans new 150 hp. boiler and automatic stoker for power plant improvements, $7,000.

DIESEL TYPE ENGINE—**Denton, Tex.**—Oct. 11, by City Comn., furnishing complete Diesel type engine with generator, installed in municipal electric plant.

BOILER and STOKER EQUIPMENT—**Sheridan, Wyo.**—Oct. 11, by U. S. Veterans' Hospital, new boiler and stoker equipment at U. S. Veterans Administration.

PUMPING PLANT EQUIPMENT — **Madras, India**—Nov. 2, by D. D. Warren, comr. Electrical Dept., Corp. of Madras, supplying erecting waterworks pumping plant, consisting electric motors, pumps, switchgear and accessories at Kilpank Pumping Station.

PUMPS — **Mysore, India** — Municipality of Mysore, c/o Chief Engineer, soon takes bids pumps to increase water supply from 2½ m.g. to 4 m.g.